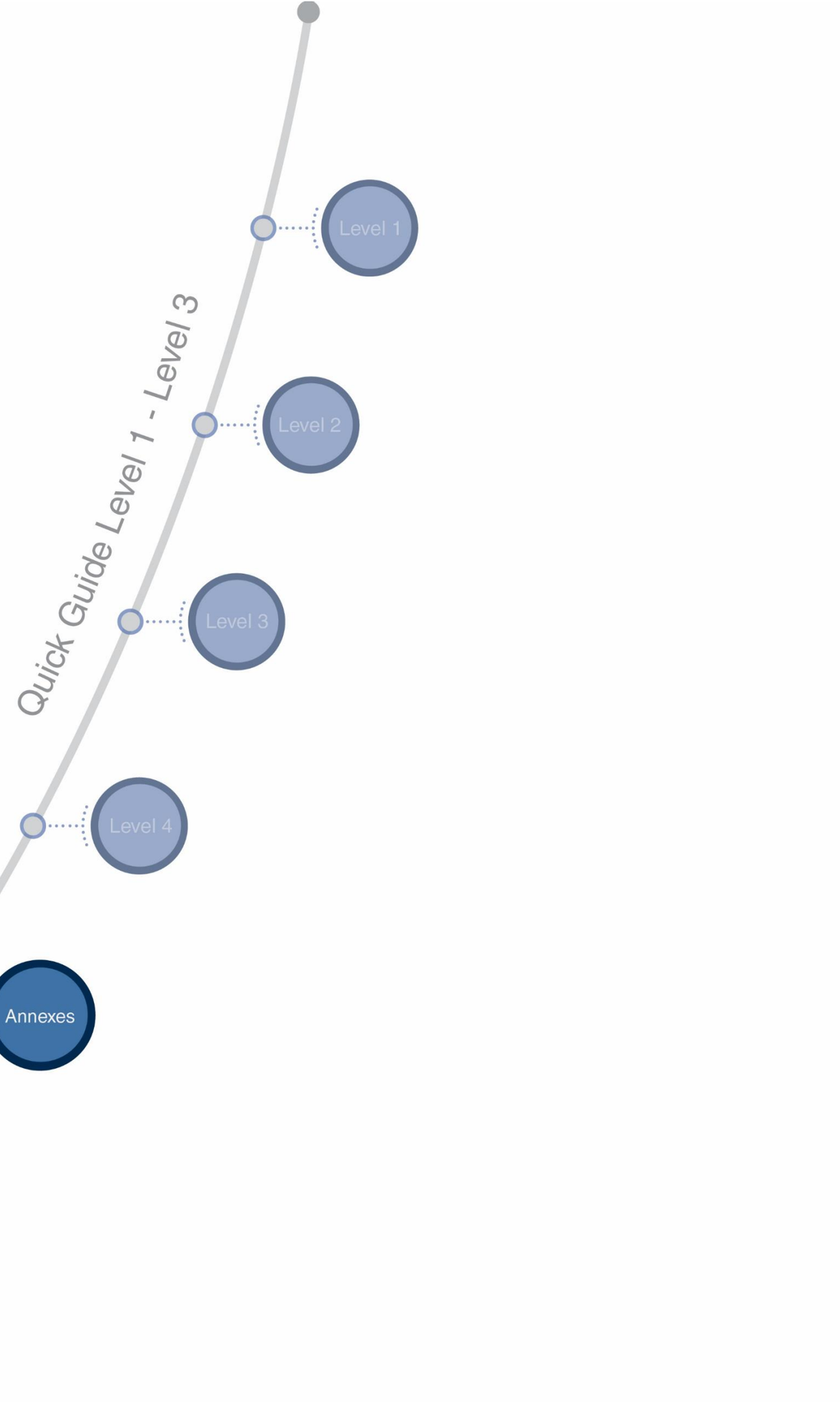
ANNEXES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1 BIM Studies Done by Various Professional Disciplines in DCD of the HA

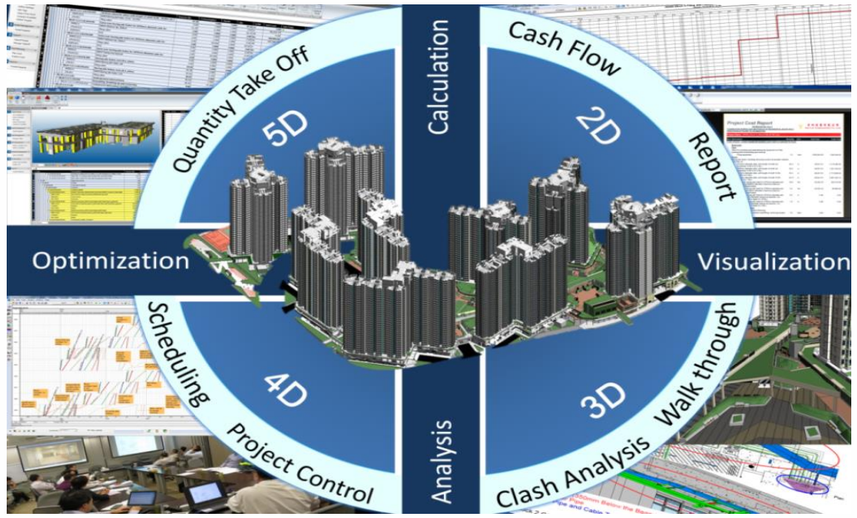
Item	Section	Title of BIM Studies	Contact Point for the Discipline Design Guides	Sources of Write-up
1	CA/D&S	Towards Customization with Standard Modular Flats in Mass Housing Design	A/66	Autodesk BIM Awards 2009
2	CA/2	Pilot use of BIM in New Public Housing Project of Tung Tau Cottage Area East	SA/26	Autodesk BIM Awards 2010
3	CA/D&S, CSE/1 and CSE2	Innovative Use of BIM for Sustainable Construction in Public Housing Development of the following Projects (i) Tai Pak Tin Street Public Housing Development; (ii) Redevelopment of Lower Ngau Tau Kok Estate; and (iii) Redevelopment of So Uk Estate.	CA/D&S, CSE/1 and CSE2	Autodesk BIM Awards 2011
4	CQS/2	Pioneering BIM for Quantity Surveying in Public Rental Housing - Shui Chuen O Phase 1	SQS/PS	Autodesk BIM Awards 2012, buildingSMART BIM Awards 2015
5	CA/4, CSE/2,CQS/2	Optimization of design options by value management with BIM technology for Hin Tin Street HOS project	SA/12	Autodesk BIM Awards 2013
6	CSE/2	3D print-out of the Site Sub-soil BIM model - Wang Yip Street West HOS site	SE/75	Autodesk BIM Awards 2013
7	CGE/2	Integrated Use of BIM and GIS - Civil 3D/GIS/Revit (CAR Approach)	SGE/5	Autodesk BIM Awards 2014
8	CQS/2	Lighting Simulation and Rendering by DiaLUX	SBSE/C3	Autodesk BIM Awards 2014
9	CSE/2	RFID and BIM-Enabled Logistic and Supply Chain Management of Prefabricated Housing Production In Hong Kong	SSE/4	Autodesk BIM Awards Submission 2015
10	CSE/1	Demolition for Redevelopment of Lower Ngau Tau Kok Estate	CSE/1	buildingSMART BIM Awards 2015
11	CA/3	5D BIM at Anderson Road Site A & B (ARAB)	SA/18	
12	CSE/2	BIM-enabled Semi-automatic Foundation Design (SAFD)	SSE/4	
13	CBSE/2	Using BIM Model to obtain Building Data for RTTV Calculation	SBSE/C3	
14	SLA/1	Customization of Soft Landscape Library for BIM	SLA/1	

2 BIM Study - Public Rental Housing Development at Anderson Road Site A and B Phases 1 & 2 - Innovative item - 5D BIM Application

Background

In Hong Kong construction industry, BIM has been adopted for many years to increase collaboration between different stakeholders along the building lifecycle.

Primarily BIM uses like visualization (including renderings, walkthroughs, mass model studies, and simplistic 4D animations used primarily for presentations), design documentation, design coordination, clash detection, model-based analyses like 4D simulations to establish relationship between schedule and sequence on construction activities are being used.



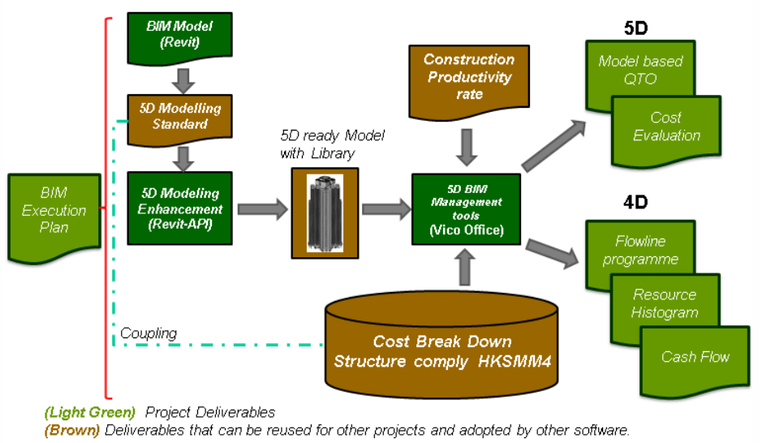
Above mentioned BIM uses lack integration analysis that would combine project information like design, cost, programme, estimates, etc, into one analysis (which is also termed as 5D BIM).

In 5D BIM, stakeholders can analyse cost and time impact to aid in design decision, resulting in fewer changes and delays and ultimately greater benefits to the project owner. 5D BIM can be utilized for quantity take off (QTO), generating estimates, creating flowline programme and generating cash flow analysis. It also enables the project team to make informed project management decisions like generating cost & resource loaded schedules, iterative estimates & schedules for project team to quickly compare target cost vs. actual cost and analyse of project risks, leading to improved understanding of project progress and enabling effective and informed decision-making.

Objectives

- Implementing 5D BIM Technologies and Work Flows in both Design and Execution Stages of this project.
- Developing 5D BIM Modelling Standard – Define modelling requirement of each element, naming principle and most importantly the linkage of QTO in relation to Hong Kong Standard of Measurement of Building Works (HKSMM4) principles.
- Creating cost breakdown database in compliance with HKSMM4 for automatic extract of component quantities.
- Exploring new construction scheduling approaches – Location-based management system (LBMS) and flowline scheduling concept.
- Project management.
- Model-based QTO to facilitate cost estimation & programme optimization.
- Developing project productivity rate for different trades of works.

Methodology



(Light Green) *Project Deliverables*
(Brown) *Deliverables that can be reused for other projects and adopted by other software.*

- Reviewing local and overseas standards of Cost Breakdown Structure, including Elemental based Quantity Takeoff system NRM (New Rules of Measurement) from UK, Uniformat from the United States, SMM2 from Malaysia and Singapore, etc.
- Examining limitations and opportunities for HKSMM4 to facilitate model-based QTO.
- Developing a Hong Kong specific Cost Breakdown Structure (CBS). The CBS maps between the trade-based (from Hong Kong construction practice) and elemental-based QTO (from BIM).
- Reviewing the HA in-house modelling standards to identify gaps with the proposed modelling approach, i.e. “Standard Approach of Modelling (SAM) for Creating Building Information Structural Model” version 1 published on March 2014, and FLIP Revit Family Naming Approach.
- Building 3D BIM models according to normal practice.
- Developing model enhancement standards (including geometry, naming and attribute requirements) that would upgrade the Basic BIM of ARAB project to 5D BIM models from 3D BIM models, and allow extraction of building quantities comply with HKSMM4.
- Implementing the established model enhancement standards for various locations and trades. Sharing the incremental results with the HA core team, and refining the approach and requirements based on feedback.
- Reviewing construction process according to the as-planned programme to monitor site progress based on model-based quantity and task productivity rates by using a 5D BIM management platform (Trimble VICO Office).
- Refining the works sequence and/or productivity rates to accelerate the site progress in the 5D BIM model for project management use.

Scope of Application and Status

Model-based Cost Evaluation –

(1) Developing Methodology – Under development
(2) Scope of Application
  a. BLK 3 – Ready for Final Review
  b. BLK 9 – Under development

Programme Monitoring –

(1) Developing Methodology – Ready for Final Review
(2) Scope of Application
  a. Site B Large Diameter Bored Piles - Completed
  b. Site B Socket H Piles - Completed
  c. BLK 1 to 9 Structural Framing – Completed
  d. BLK 3 Major Trades – Under Development
  e. BLK 9 Major Trades – Under Development

Programme Optimization –

(1) Developing Methodology – Ready for Final Review
(2) Application for ARAB Project Management
  a. BLK 1 Roof Level (LMR to UR) – Completed
  b. Site B Wet Market Building Services Installation – Under Development

Restrictions and Limitations

- For basic modelling, some structural elements are not modelled, for example, rebar, formwork, conceal conduit and temporary structure. The reason is that they are not within the scope of BIM Specification of HA standard and they are not being modelled in general practice in Hong Kong. Although these elements are within the bill of qualities, they are not in model and therefore cannot make use of the 5D BIM Model based QTO function.
- The ARAB basic 3D BIM models did not comply with HKSMM4. For 5D BIM Model based QTO, model enhancement has to be applied to meet the requirements.
- In the beginning, it took longer to gather information such as detail task breakdown and productivity rates from site team members to develop the 4D BIM construction programme. It also required personnel with actual project management experience to execute the process.
- As this is an IPA project, PQS has to use the Bills of Quantities (BQ) agreed at the start of the project based on preliminary design information, rather than an updated BQ based on the finalized design. Therefore, the payment amount and interim payment report generated by the 5D BIM could not be used to reference or compare with PQS's version.

Results / Findings

- Using the bimSCORE Framework and the four areas of Planning, Adoption, Technology, and Performance, the value of 5D BIM was measured to objectively assess its benefits to the overall project management goals. Detailed findings for each of the four areas are described as followed *(see Figure 1 below: bimSCORE 5D BIM Evaluation for ARAB)*

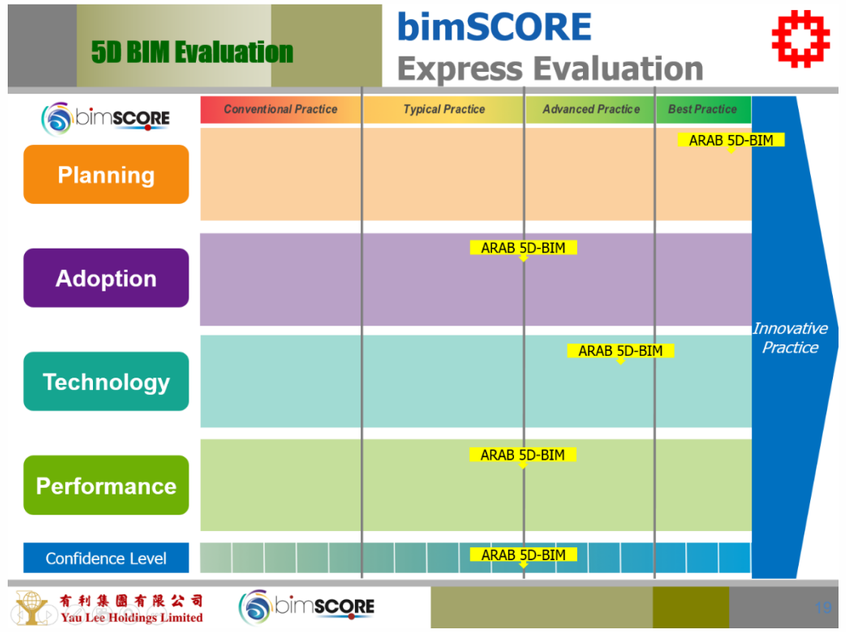


Figure 1

Planning:

Assessing different standards for 5D BIM execution, staff training, preparation of IT infrastructure for 5D BIM adoption, and setting up objectives for development of 5D BIM models.

- **Quantifiable objectives** were established that benefited a broad range of stakeholders such as client, main contractor, sub-contractors and suppliers etc.
- **Project-specific and Region-specific Standards** were developed that would contribute to Industry Standards, e.g. 5D BIM modelling approaches and modelling guidelines for model-based quantity take-off complying with HKSMM4 will be documented for ARAB and future HA projects.

Adoption:

Defining required deliverables delivery methods, and phases of BIM involvement.

- **Understanding of project progress** during Weekly Project Meetings by using 5D BIM-generated results.
- Enabling **effective** and **informed** decision-making.
  - For example, the 5D BIM generated results that projected the schedule would be delayed in the construction of Socket H Piles. The Main Contractor (MC) conducted multi-stakeholder discussion sessions to resolve the issue based on the 5D BIM report. As a result, this risk was mitigated before construction of the piles reducing project delay.
- P**roject risks** were analysed with model-based quantities and agreed upon production rates.
  - Slow productivity rates were identified in the flowline diagram for construction of large diameter bored piles. This allowed the team to adjust the programme and resources. The team was able to generate reports based on model quantities and agree productivity rates of each week (normally would take 3 weeks) via Vico Office Reporting Modules. These reports enabled the team to evaluate the impact of the additional socket H piles to plan better site logistics and materials procurement, understand the cost variation and time implication for different alternatives.
- **Exploring alternative construction method** with sub-consultants
  - MC projected a delay in Block 1, and in order to mitigate the delay, alternative rooftop construction was explored with sub-consultants. HA and MC could decide to adopt a precast option within one meeting. Using 5D BIM, MC only used one man-day to retrieve relevant data, produced programme and cost estimation for the pre-cast option. The estimates projected significant savings in construction time, which allowed MC to confidently adopt the precast option with a clear understanding of the expected savings in construction time. The 5D BIM forecasted 117 days and 63 days for the traditional construction approach and the precast option respectively. The actual rooftop construction using the precast option took 65 days, achieving a 44% programme savings when compared against traditional construction.

Technology:

Evaluating the maturity of BIM applications, how well BIM covers the project scope, and the integration of data and models between different BIM applications.

- Explored and implemented **model-based estimates**, **programme planning and monitoring**, and **risk analysis** to a wide range of elements of different trades
  - **Model-based Construction QTO**
    - Generate Bill of Quantities quickly
    - Update quantities quickly when design changes
    - Trace measurement details to support payment application during construction
  - **Model-based Estimation**
    - Support the estimation to make use of historical cost data
    - Visualize each building element's estimation details
    - Check the budget against actual cost for certain items during construction
  - **Model-based construction Process Simulation**
    - Simulate the construction procedure for better planning and design coordination
    - Support clash detection to avoid any conflicts and abortive works
  - **5D Simulation**
    - Visualize and monitor the comparison between actual and planned programme
    - Overview the total and key resources expenditure during construction
  - **Model-based Risk Management and Project Control**
    - Identify risks early
    - Real-time overview of performance to support critical business and management decisions
  - **Developed Automation Tools in REVIT** to speed up model enhancement processes needed for local compliance of estimates

Performance:

Focusing on qualitative and quantitative tracking of objectives with performance metrics

- Achieved **satisfactory QTO accuracy** through iterative and continuous collaboration with HA Q.S. Service Team
- Highlighted deficiencies in conventional work flow and the importance of using 5D BIM to validate feasibility of programme proposed by sub-contractors

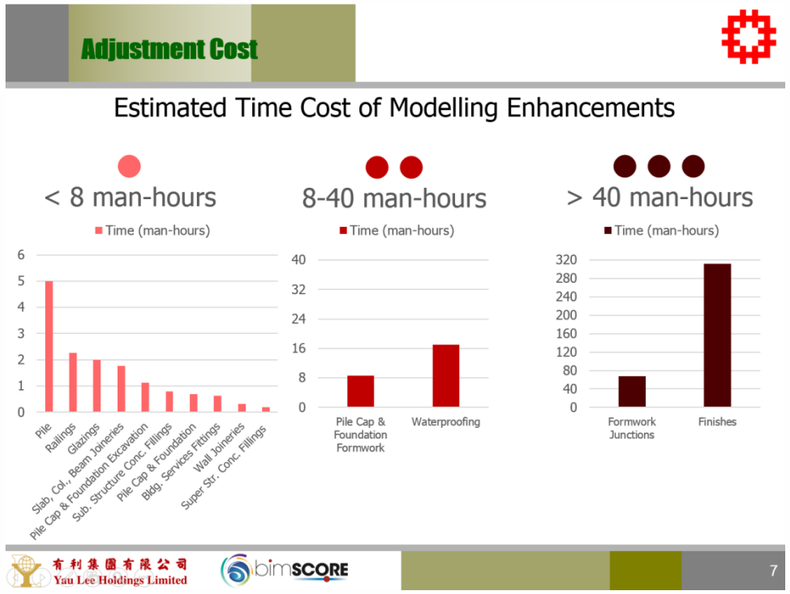


Figure 2

Study of BIM for Quantity Takeoff to Support Cost Estimation:

Domestic Block 3 (substructure and superstructure) and Domestic Block 9 (substructure) models were used to study the modelling enhancements required to support quantity takeoffs (QTO) for cost estimation. 78% of QTO BQ items were based on model quantities, with the remaining 22% of QTO BQ items based on non-model quantities from 2D drawings. Out of the 78% QTO BQ items that were model-based, 43% required modelling enhancements for the QTO to comply with HKSMM4 standards.

Modelling enhancements required for QTO were studied to understand the time required to perform the adjustments for the objects associated with each QTO BQ item. The calculation of additional modelling time included various steps, e.g. reviewing of reference documents, filtering and searching of elements, editing, and reviewing the model adjustments by domain specific consultants. See *Figure 2 below: Estimated Time Cost of Modelling Enhancements* showing time required for modelling adjustments.

3 BIM Study - BIM-enabled Semi-Automatic Foundation Design (BIM-SAFD)

Brief Description of the Application

In conventional foundation design, Structural Engineers use various discrete software, such as ETABS, SAFE, Surfer or Civil3D (***Figure 1***), for performing structural analysis and design. Even though there is clear proliferation of a wide variety of design tools, there has never been a platform available for data interoperability through which different software work together effectively for instant information exchange, not only to ensure seamless information flow but also to improve the accuracy and enhance the efficiency of design process.

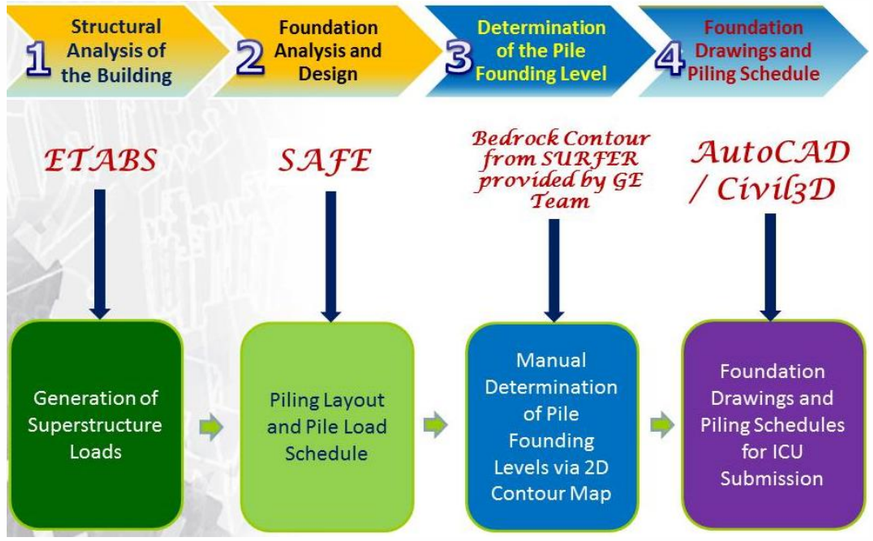


Figure 1 – Workflow of Conventional "One-way" Foundation Design

The Structural Engineering Section therefore developed more responsive solutions with one-stop integrated foundation design with Building Information Modeling (BIM) for providing designers a platform for data interoperability, and devising a set of standard approach of modeling and method of measurement to bridge the gap of a BIM-based estimation or quantities take-off that is compatible with the standard and practices of measurement in the industry. This one-stop design solution: **Semi-Automated Foundation Design** (**SAFD**) using Surfer, and its integration with BIM REVIT, brings about a revolution in the way the foundations are designed, drawings are produced and quantities are measured to achieve design and drawing production optimization, and most importantly, enhancing design accuracy and efficiency. ***Figure 2*** shows the conceptual workflow of **BIM-SAFD** in comparison with the manual design approach.

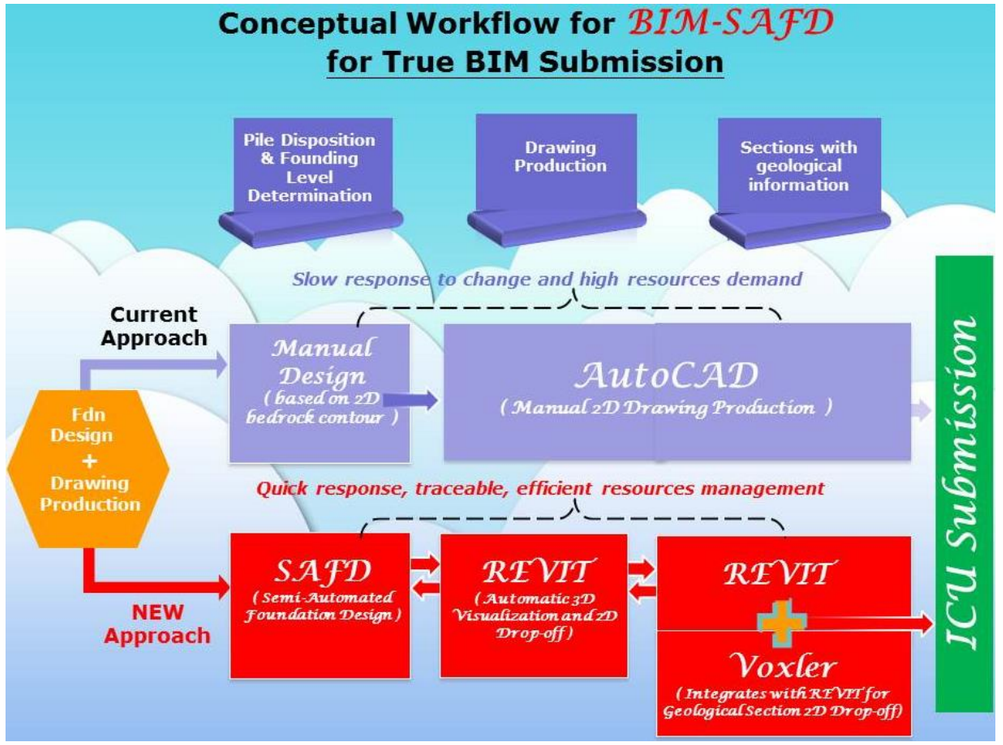


Figure 2 – Conceptual Workflow for BIM-SAFD

BIM-SAFD is ready for use for foundation design and preparation of submission to the Independent Checking Unit (ICU). In fact, there are a number of projects with foundation plans already approved by the ICU. The application will be used for forthcoming foundation submissions and quantity estimation.

Methodology

Semi-Automated Foundation Design (SAFD)

While BIM can detect if two objects are clashing in space, there is no built-in function in Autodesk REVIT to ascertain whether a pile object is "clashing" or "penetrating" through the rockhead contour, as only a 3D surface is viewable in Autodesk REVIT. In addition, Autodesk REVIT does not have function to determine the rockhead level of each pile based on the rockhead contour surface and location of piles (***Figure 3***).

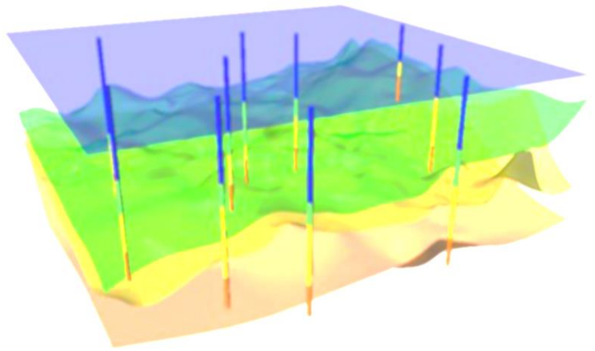


Figure 3 – Drillholes and Rockhead Contour Surface

SAFD consists of two main design tools: ***Surfer (ver. 12)*** - a full-function 3D visualization, contouring and surface modelling software which is used extensively for 3D surface mapping; and an ***Add-on Programme of Microsoft Excel workbook*** for correlating the design output from Surfer with the design constraints. **SAFD** enables the determination of rockhead level of each pile and automatically identifies the coordinates/levels of the intersection of the piles with the rockhead. It provides a platform through which the results output from analytical software can be shared and interacted proactively with BIM to facilitate Engineers to make a prompt, systematic and precise decision.

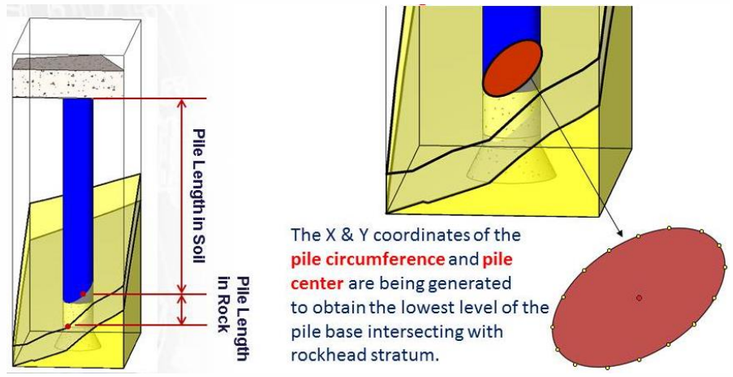


Figure 4 – "Grid Residual" by Surfer

Using the 3D functions in Surfer, Engineers generate the 3D rockhead contour from geological data, allowing automatic determination of the intersecting points of the pile with the rockhead stratum (i.e. the rockhead level of each pile) at fixed coordinates along the pile circumference by "Grid Residual" function as illustrated in ***Figure 4***.

Once the rockhead level of each pile is determined by Surfer and the founding level of each pile are fixed, design constraints such as "stepping" effect due to stress overlapping with adjacent piles and adverse bedrock contour of founding level can be visualized through the aid of the add-on programme.

In ***Figure 5***, piles which are affected by the overlapping stress of adjacent piles are highlighted in different colours. A summary of the stepping effect among the piles can also be generated for subsequent overlapping stresses checking.

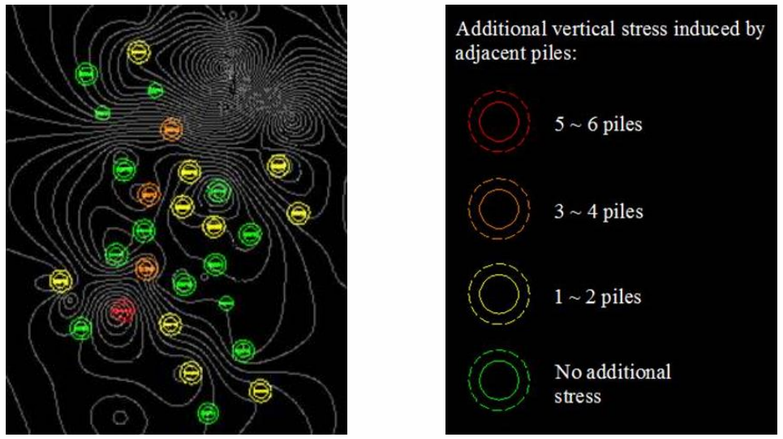


Figure 5 – Summary of Pile Stepping Effect

To check if there is adverse bedrock contour, twelve sections of bedrock profiles each at 15° intervals on plan will be examined as illustrated in ***Figure 6(a)***. Any rockhead profile with gradient greater than the pre-determined threshold angle (e.g. 45°) is highlighted in red in ***Figure 6(b)***. Such steep bedrock profile underground will have to be further investigated by Geotechnical Engineer to ascertain whether there is sufficient factor of safety against sliding.

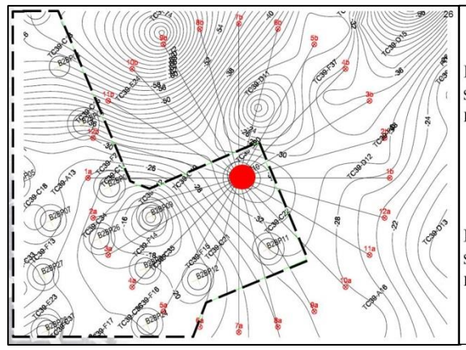


Figure 6(a) – Checking of Steep Bedrock

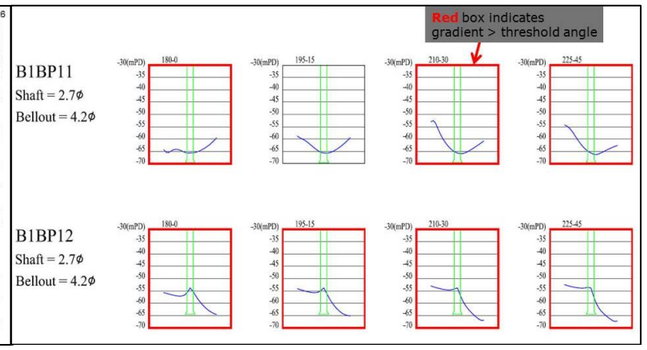


Figure 6(b) – Steep Bedrock exceeding Threshold Angle

It is particularly important as these constraints may affect the disposition and depth of substantial number of piles within a domestic block where several localized weak seams, stepping effect and steep bedrock are found. All these have to be separately considered by Structural Engineers. With the automatic detection of founding level with visualization of different critical design constraints, pile optimization can easily be completed with increase in confidence on design accuracy.

Integration of SAFD with BIM in enhancing efficiency and accuracy of Foundation Design

Design development through the **SAFD** is further incentivized by integration with BIM, bringing in benefits such as interactive visualization platform, automated drawing productions in either 3D or 2D form, and standardized data exchange interfaces for quantity measurement.

Standard Approach to Modeling (SAM)

To provide an easy startup for BIM model construction, BIM Service Team (BIMST) has devised an Autodesk REVIT Structure project template as part of the Standard Approach to Modelling (SAM) in which there is a component library with shared parametric files developed for building the Autodesk REVIT models. The construction of Autodesk REVIT families for customization of all foundation–related elements is the key to standardization. Appropriate foundation-related family categories will be applied to the modelling of different structural elements with details as shown in ***Table 1*** below –

Table 1 – Autodesk REVIT Family Categories for Structural Elements

Structural Element	Autodesk REVIT Family Category
Column, post and hanger	Structural Column
Shear wall, core wall, bearing wall, hanger wall, stud wall, screen wall, parapet	Wall (Structural Wall type)
Beam and lintel	Structural Framing or Beam System
On-grade slab and mechanical plant base	Structural Foundation (Slab type)
Cap, footing and pile	Structural Foundation
Other elements (e.g. plinth, mass fill, fillet and curb, etc.)	Generic Model (In-Place)

2D Drop-off for Statutory Submission

Upon completion of the foundation design, ground investigation (GI) logs and contour information in DXF format will be exported through a geotechnical software, Voxler (**Figure 7**), to Autodesk REVIT model (**Figure 8**) for 2D drop-off, including plans, geological sections and piling schedules.

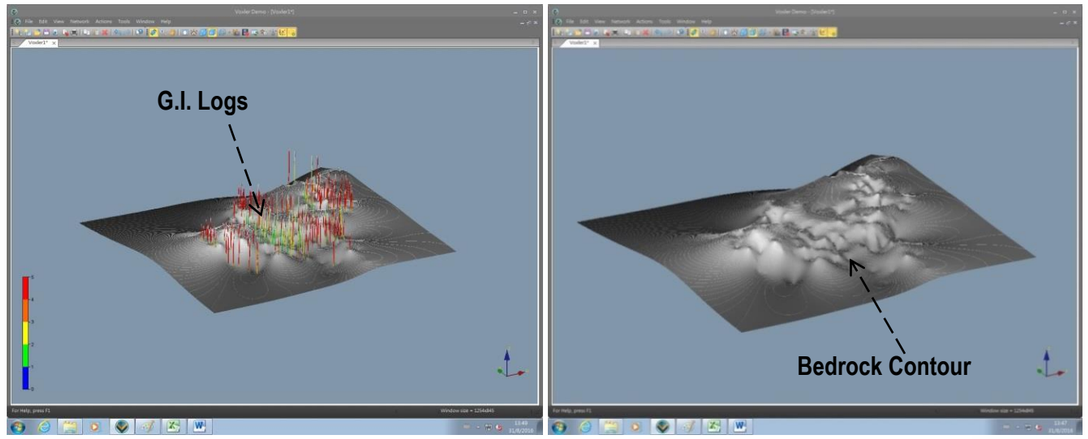


Figure 7 - GI logs and Bedrock Contour Information generated by Voxler

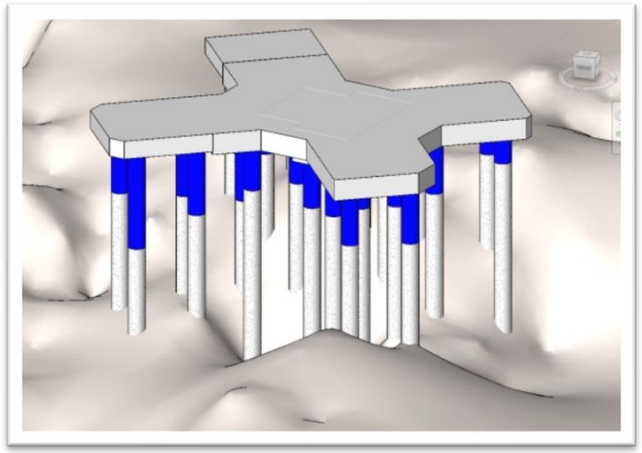


Figure 8 - Bedrock Contour Visualization by BIM with Data exported from Voxler

Figures 9(a) to (d) compare the manual drafting with AutoCAD and automatic 2D drop-off from Autodesk REVIT on piling layout plan, pile cap layout plan, geological sections and piling schedules respectively. The presentation and quality of drawings from Autodesk REVIT 3D model not only remain the same as before, but are also free from discrepancies amongst plans, sections, details and schedules as they will automatically tally with one another. Any revisions in the 3D model and any changes in one file will be instantly updated and reflected in the others.

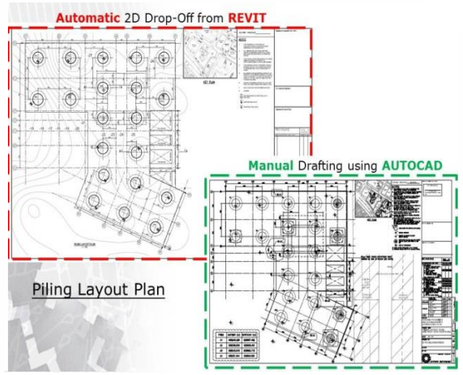
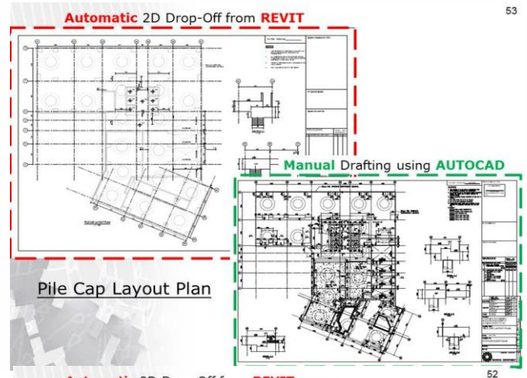


Figure 9(a) – Piling Layout Plan (REVIT vs AutoCAD)



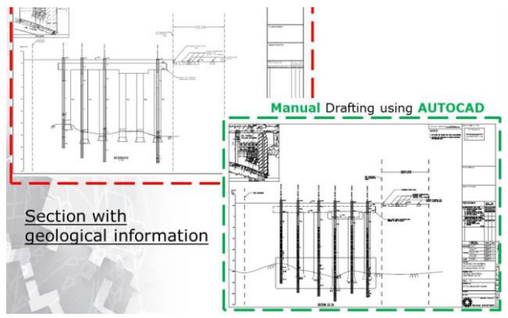


Figure 9(c) – Geological Section (REVIT vs AutoCAD)

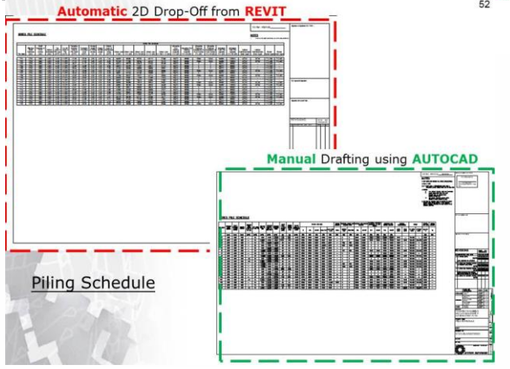


Figure 9(d) – Piling Schedule (REVIT vs AutoCAD)

As a result, the 2D drop-off with combination of structural elements, rockhead contours and GI data merges into one single 3D model, which will then be used (see the workflow in ***Figure 10***) for foundation submission to the ICU.

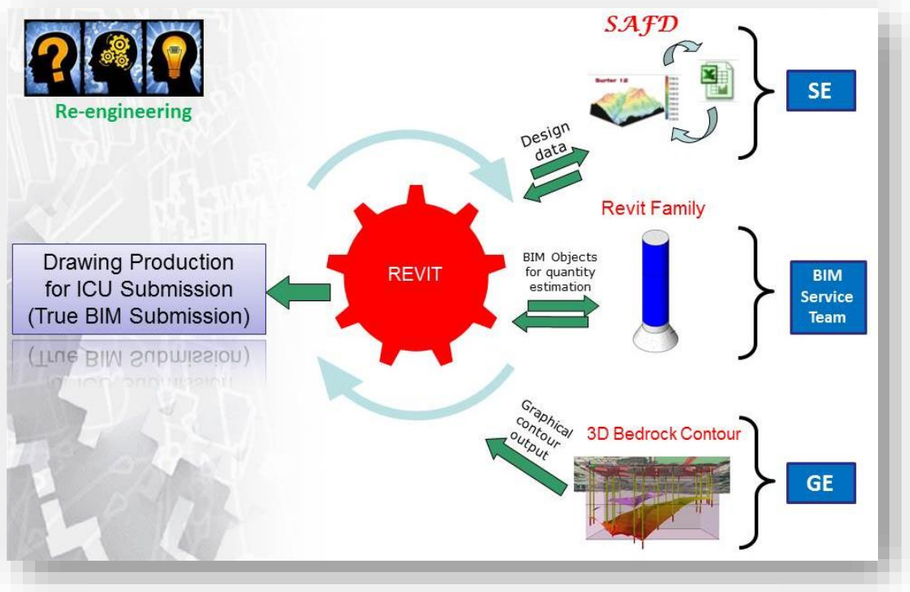
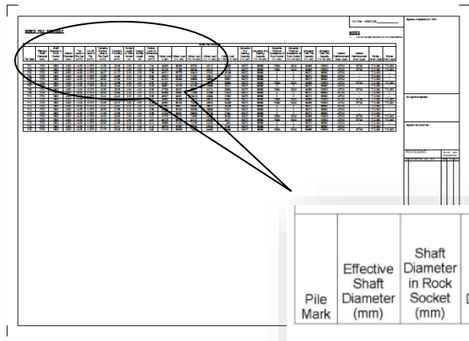


Figure 10 – Workflow of BIM-SAFD for ICU Submission

BIM-SAFD Assisted Quantity Take-off (QTO)

Through **BIM-SAFD** upon completion of the foundation design, the Autodesk REVIT model will be passed to the Quantity Surveyors for cost planning and estimation for tendering preparation (**Figure 11**). SAM has incorporated the necessary modelling techniques to facilitate direct quantities extraction from the BIM model (**Figure 12**) for quick value engineering analysis. As such, all Autodesk REVIT families including data such as length of piles, material type, volume, surface area and basic dimensions can be extracted for measurement purpose.



Pile Mark	Effective Shaft Diameter (mm)	Shaft Diameter in Rock Socket (mm)	Bellout Diameter (mm)	Sleeving from Bottom Level of Pile Cap (mPD)	Top Level of Pile Cap (mPD)	Cut off Level of Pile (mPD)	Tentative Bedrock Level at Pile Shaft (mPD)	Tentative Founding Level (mPD)	Shaft Length in Rock Socket (SLIR) (m)	Design Socket Length (DSL) (m)
P01	2700	2800	4200	--	+4.50	+1.875	-24.00	-27.00	1.30	3.00
P02	2700	2800	4200	--	+4.50	+1.575	-19.50	-28.23	** 7.03	8.73
P03	2700	2800	4200	--	+4.50	+1.875	-30.40	-32.40	0.30	2.00
P04	2700	2800	4200	--	+4.50	+1.875	-38.00	-40.00	0.30	2.00

Figure 11 – Piling Schedule for Automatic Quantity Measurement in BIM

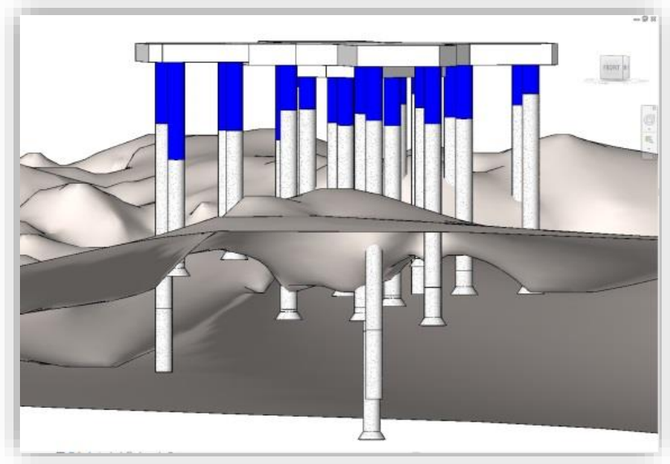


Figure 12 – 3D REVIT Model for Quantity Measurement

With **BIM-SAFD** based quantity take-off, the information in the Autodesk REVIT model can also be shared and exchanged across disciplines. With any changes in geological information resulting from new predrilling data available and changes in block disposition automatically assessed and extracted for verification, the updated cost variation can also be easily quantified with the new techniques of QTO (***Figure 13***). **BIM-SAFD** based QTO enables the information contained in the model to be exchanged amongst different disciplines spontaneously which shortens the time to assess the cost implications associated with any updates in design.

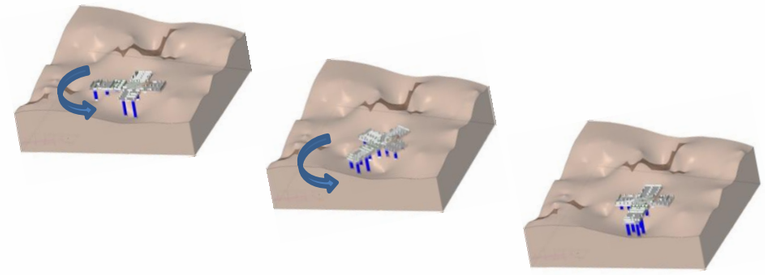


Figure 13 - Different Block Disposition for Achieving Optimum Pile Layout

Integrating **SAFD** and **BIM** brings about a breakthrough on design solution in terms of data interoperability. It effectively optimizes and streamlines the workflow of the engineering and quantity surveying professions: from manual computation by individual disciplines through design automation to multi-disciplinary collaboration via fully interchangeable information database. The introduction of BIM, a 3D interface, allows visualization of the spatial arrangement of pilings, drill holes and rockhead surface, and enables the designers to proceed with the foundation design more efficiently. Also, the design workflow becomes more traceable to supervisors or independent checkers and minimizes the risk of human errors, while ensuring the finalized BIM model containing the required quality and quantity of information is sufficient for quantity measurement.

Scope of Application

BIM-SAFD can be applied throughout the whole building construction life cycle. During the site planning and feasibility stages, different block dispositions and/or orientations can be examined to achieve the most economical design and the optimum piling layout arrangement. The 3D Revit model and the 2D drop off function are essential for drawing production in detailed design and submission stages. **BIM-SAFD** based QTO enables direct extraction of elemental data from the REVIT model for quantity estimation in tendering stage. For contract administration in construction stage, **BIM-SAFD** is highly useful as a quick tool to assess the cost implication of each variation order due to revision in pile length, prior to actual issuance of site instructions. Also, BIM-SAFD can provide quick response to any design changes due to unexpected ground condition for any informed decision to be made interactively.

Restrictions and Limitations

As **SAFD** makes use of the “Grid Residual” function of Surfer to determine the rockhead level of the piles, it is applicable to all types of piles which derived the capacities from end-bearing, such as LDBPs, socketed steel H-piles and minipiles, etc. In other words, **SAFD** is not applicable to driven piles which derive their capacities from frictional resistance.

4 BIM Study - Retrieving Building Parameters from BIM Model in Calculation of Residential Thermal Transfer Value (RTTV)

Introduction

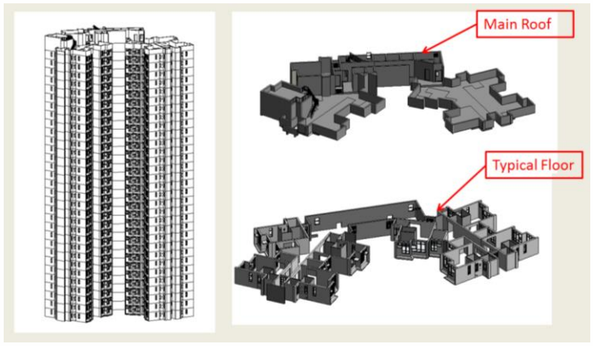
The Building Department issued PNAP APP-156 and Guidelines on "Design and Construction Requirements for Energy Efficiency of Residential Buildings" in year 2014. The assessment on the Residential Thermal Transfer Value (RTTV) is one of the requirements in applications for building consent and Occupation Permit if GFA concession is required.

Currently there is no simulation software available for the calculation of RTTV. As residential buildings form the major business profile of the HA, a more accurate and efficient method to calculate the RTTV is desired.

Since the building envelop design has direct influence to the thermal comfort of residents, our building services engineering team had an innovative venture in retrieving building parameters such as areas of wall, window and roof and required shading coefficient factors to facilitate the RTTV calculation from BIM model with the help of built-in function of Autodesk Revit, a free plug-in to identify orientations and a Quantity Take Off (QTO) plug-in to retrieve the required data.

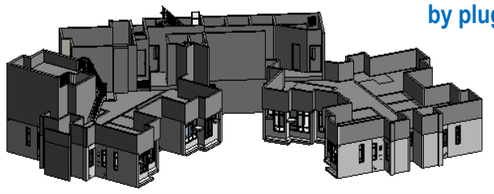
Detailed Steps of Building Data Retrieval

1. Multiple architectural model and structural model are combined into a single model to enable all external facades and internal walls can be identified without error.

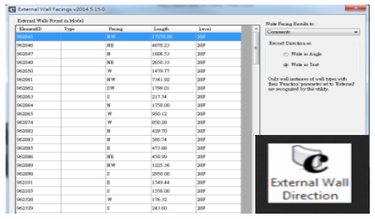


2. Currently there is no built-in function in Revit to identify the orientations of walls and windows. Our staff successfully tested a free plug-in "CASE" which can be used to identify the external wall orientations automatically. The eight directions (N, E, W, S, NE, NW, SE, SW) are indicated in the properties of the wall. The orientation of window attached to wall could therefore be identified with reference to the wall it attached as well.

Revit model



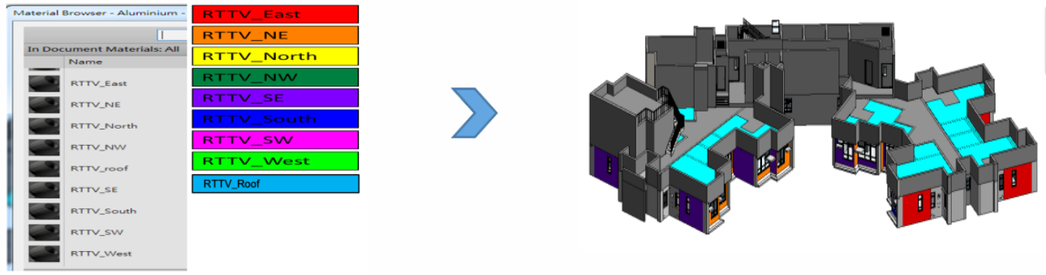
Wall orientation identified by plug-in "CASE"



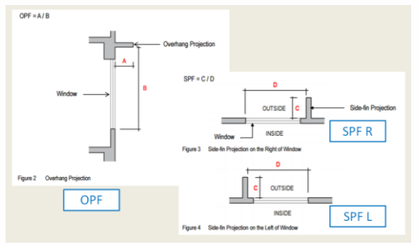
3. Nine different materials are assigned to represent the eight directions of the external wall and roof.

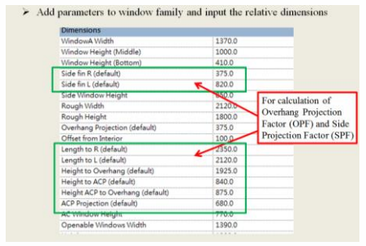
4. Apply Autodesk Revit "Paint" function to external walls and roof, according to the material assigned for each directions and roof. The function is originally used for assigning materials to different building components, but we used the materials assigned to represent orientations so as to facilitate quantity take off.

Assign different materials to roof and walls with corresponding orientations and apply "Paint"

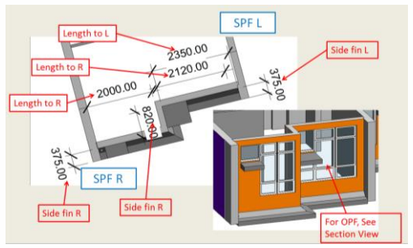


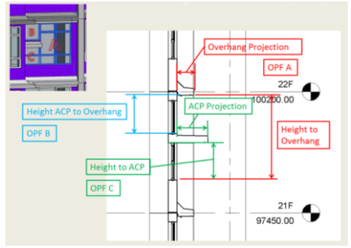
5. The Overhang Projection Factor (OPF) and Side Projection Factor (SPF) required in RTTV calculation can also be calculated by using the information contained in the window property.





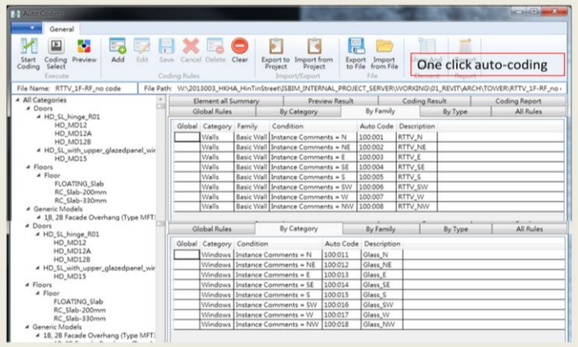
6. Window parameters such as their orientations and details of fins which have significant effect on the external shading coefficient are input to the window property.





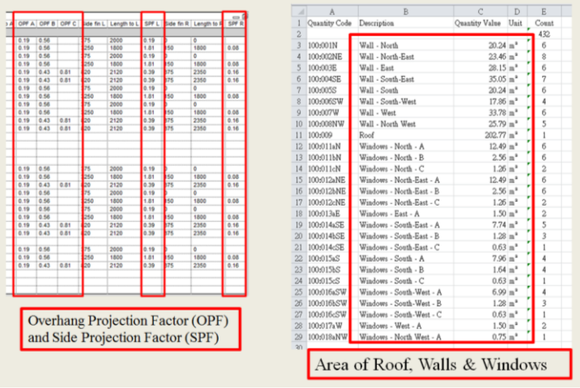
7. Perform the “Auto-coding” function of the QTO plug-in “EqBQ” to assign code for each painted elements. The sum of areas of different orientations (materials assigned) can be automatically retrieved and ready to be exported for further operation.

➢ Applying codes automatically to relevant external walls and windows with directions by a plug-in “EqBQ”, which was orignally designed for QTO. The coding can be completed in a few minutes.

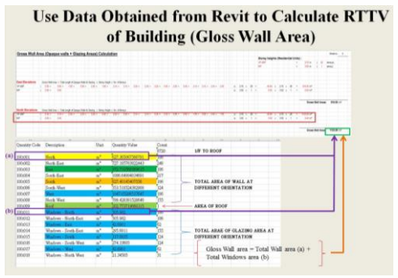


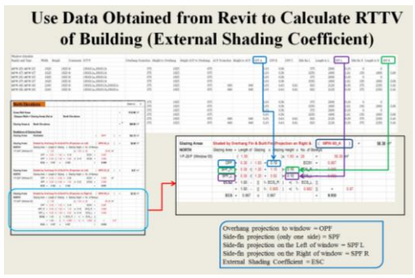
8. The area of external surfaces can be determined by exporting data to MS Excel format.

➢ All the required data are exported to Excel and ready to be input to the RTTV calculation sheet.



9. The data obtained, including the required external shading coefficients can be exported to the MS Excel to perform detailed calculation.





Conclusion

The successful trial of retrieving building parameters from BIM model to facilitate RTTV calculation brings the following benefits to our organization:

(i) The speed, traceability and accuracy of the RTTV calculation could be enhanced.
(ii) The manpower resource to perform the calculation could be reduced.
(iii) A building envelop design of better energy efficiency and human comfort could be developed through design optimization.

Way Forward

There is room to further automate the calculation in using retrieved data and the various formulae in the Guidelines on “Design and Construction Requirements for Energy Efficiency of Residential Buildings”. The acceptability of ICU on this application will be further explored.

5 BIM Study - Shading Analysis and Glare Analysis of PV Panel

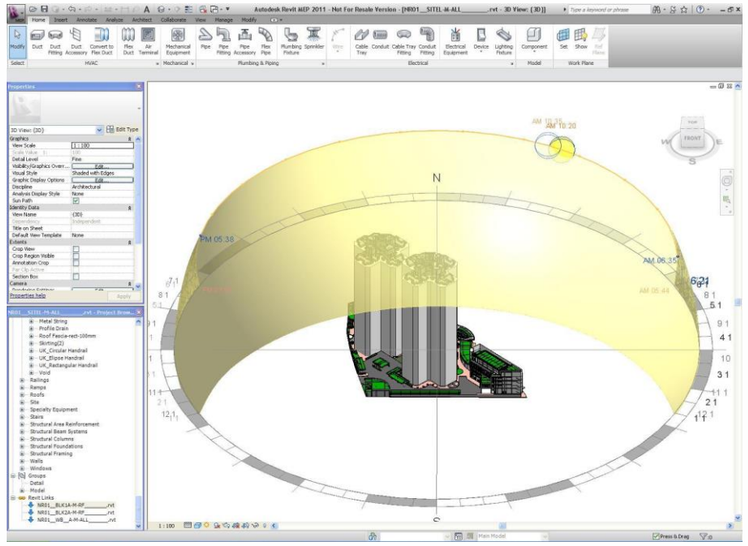
(a) Shading Analysis of PV Panel

Introduction

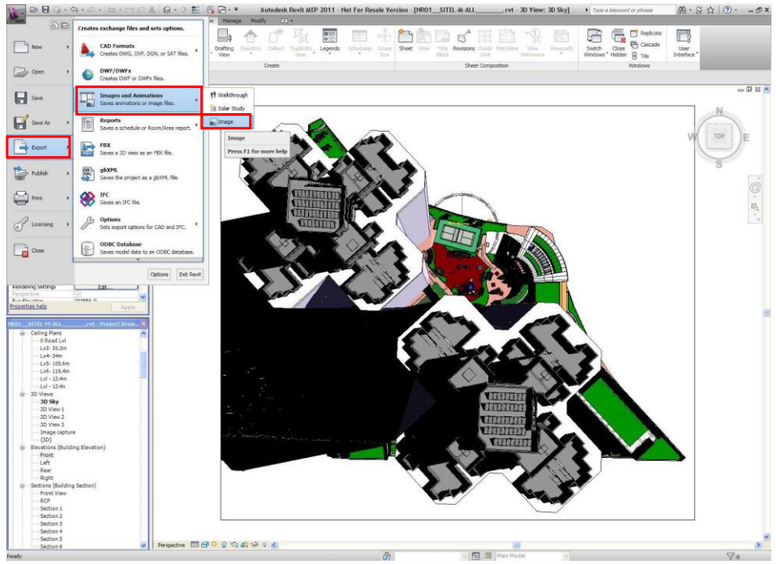
Shading analysis is a very crucial step in finalizing panel locations in distributed PV panel installation by BIM. The extent of rooftop area required by PV panels is factor of panel efficiency and extent of shading. A shade in one panel not only reduces the efficiency of that panel but cuts short supply from entire string. Therefore Revit can perform a solar study to simulate a sun path from sunrise to sunset. The entire process can be export to an animation.

Export the Image and Animation of Sun shading Study

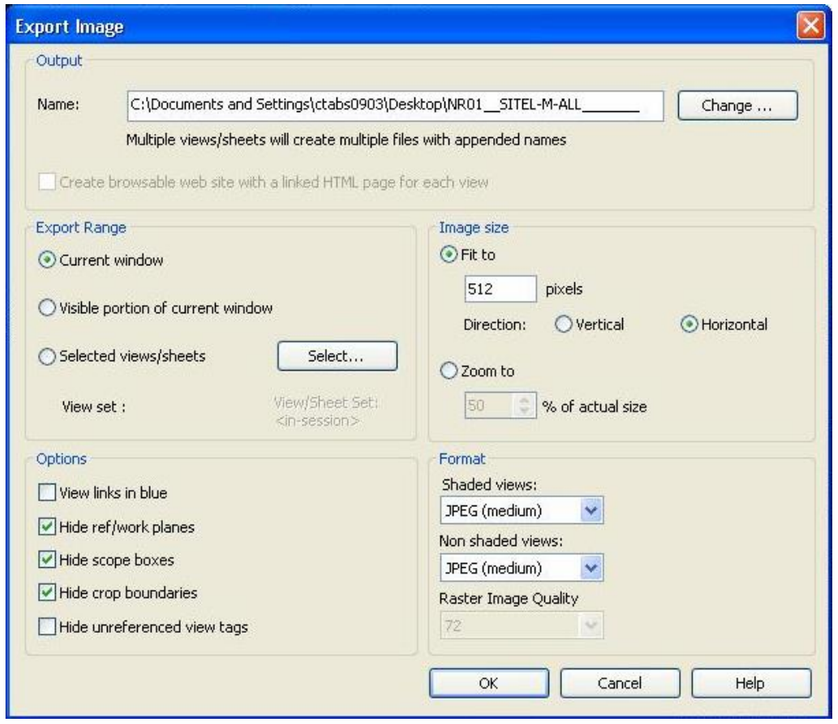
a. Instance dragging of Sun Position in 3D View, Sun Path Simulation



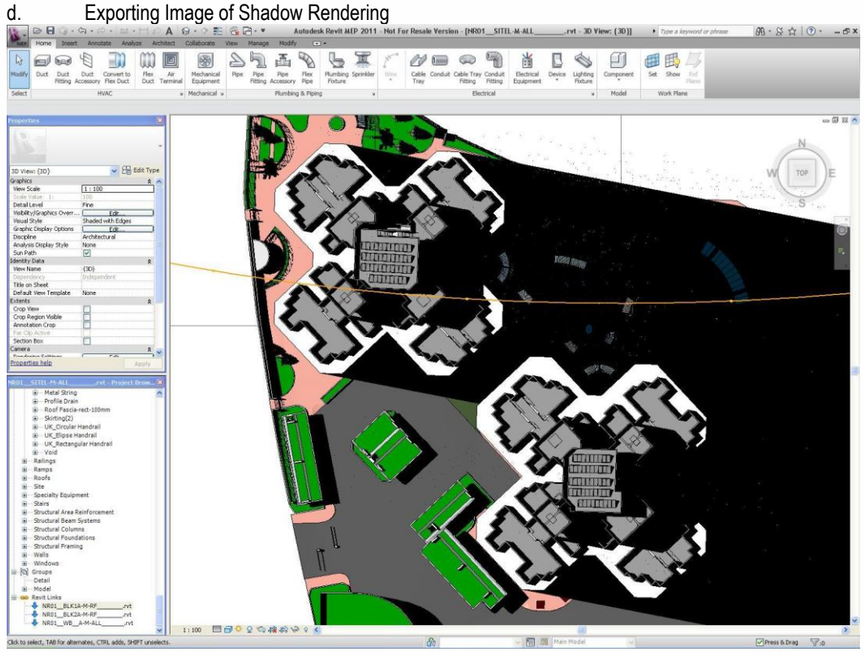
b. Set to Camera View, Click  > Export > Images and Animation



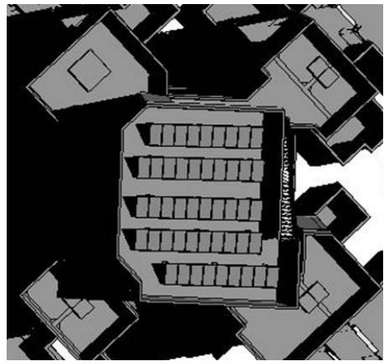
c. At Export Image Dialog, user can set export format in bmp, jpg, Png, targa & tiff



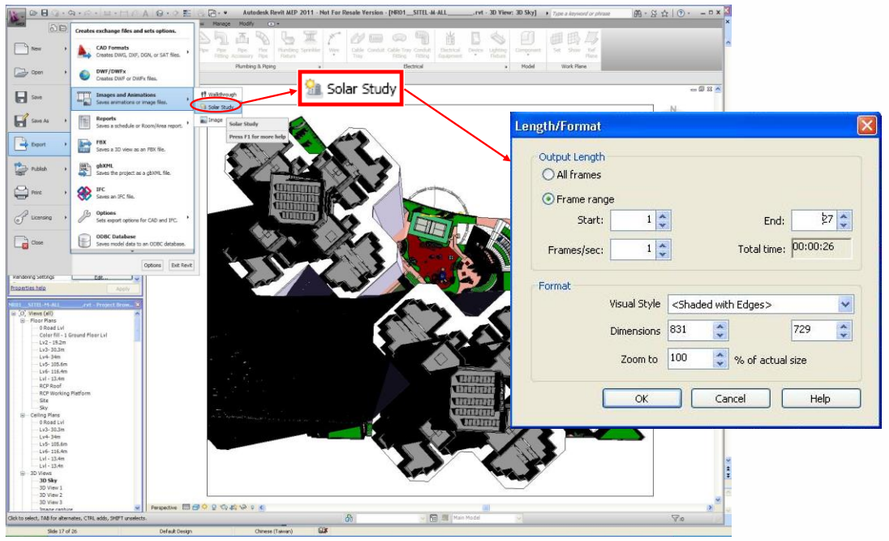
d. Exporting Image of Shadow Rendering



e. Check and ensure PV panels are not located in shading area



f. Exporting Animation, Click Click  > Export > Images and Animation.



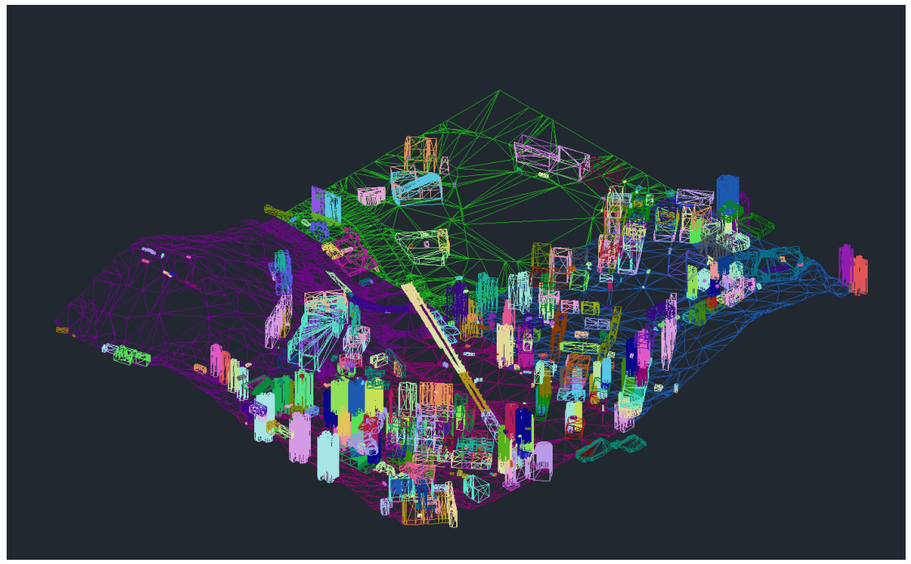
(b) Glare Analysis of PV Panel

Introduction

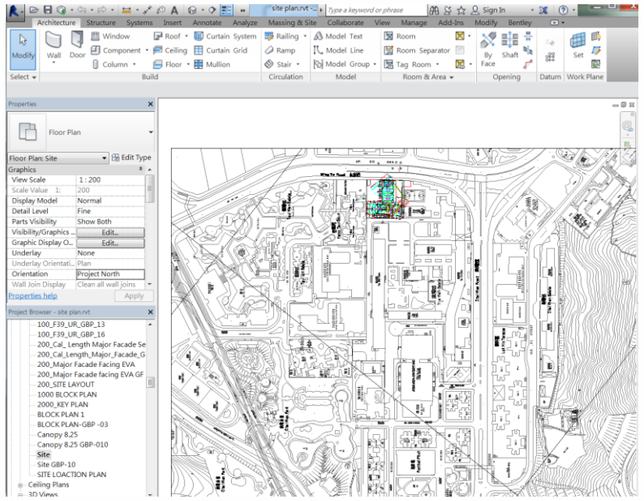
Glare can give a visual discomfort to someone if the sunlight from the PV panels reflects to surrounding buildings. Thus Glare analysis is simulating a reflection from the PV panel to surrounding building. The selected date always uses the Winter Solstice because the location of the sun is most tilted.

Detailed Steps of Glare Analysis

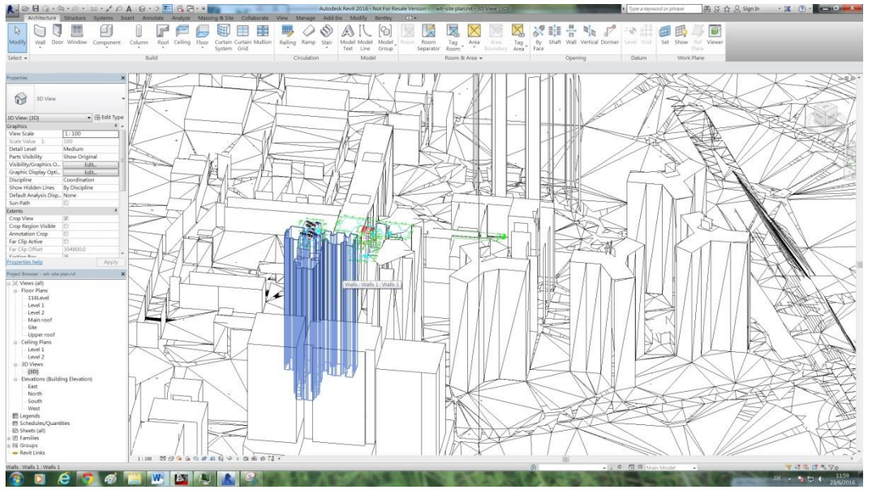
a. Receive the 3D spatial data in 3ds format from arch section, this file is the Digital map data from Land surveying unit, and then change the format 3ds to drawing using Autocad.



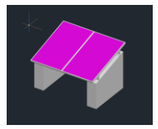
b. In Revit 2016, import the dwg file to fit the site model of Revit file.
(Make sure the site model is set to “True North”)

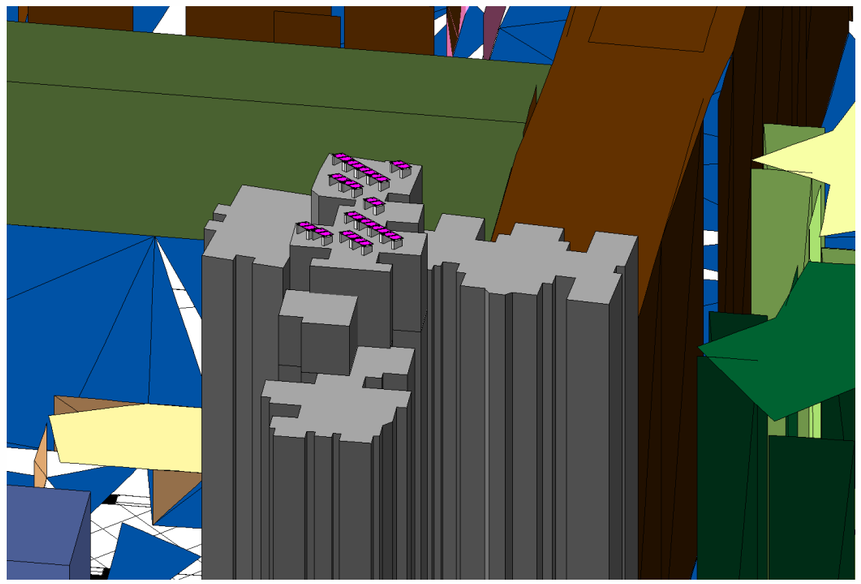


c. Create the building using Extrusion

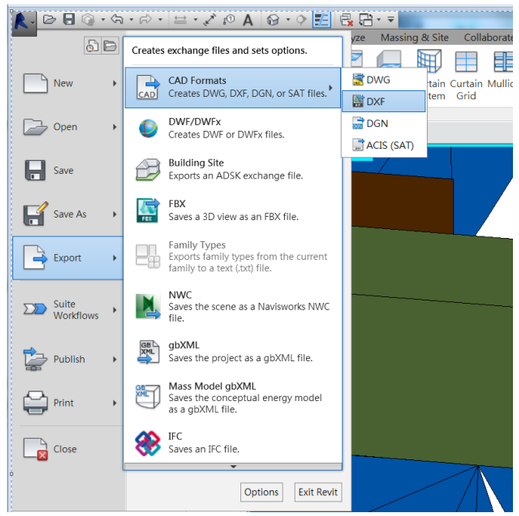


d. Place the PV panels on the Upper roof

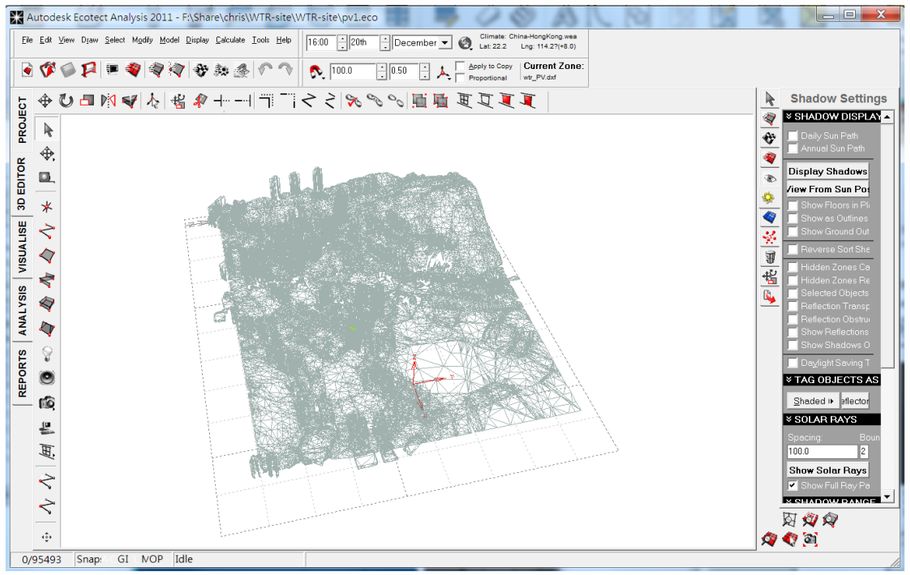




e. Export the the model to DXF format file for Ecotect

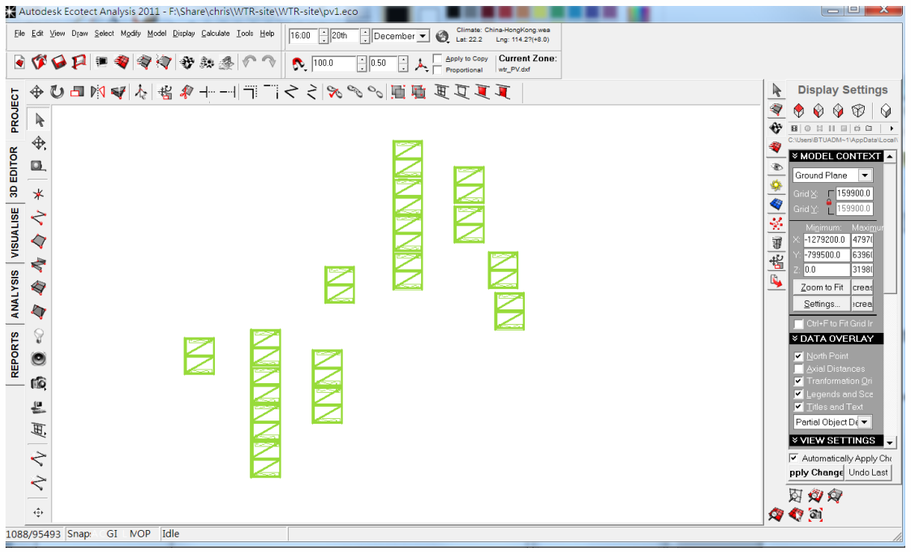


f. In Ecotect 2011, import the 3D CAD Geometry

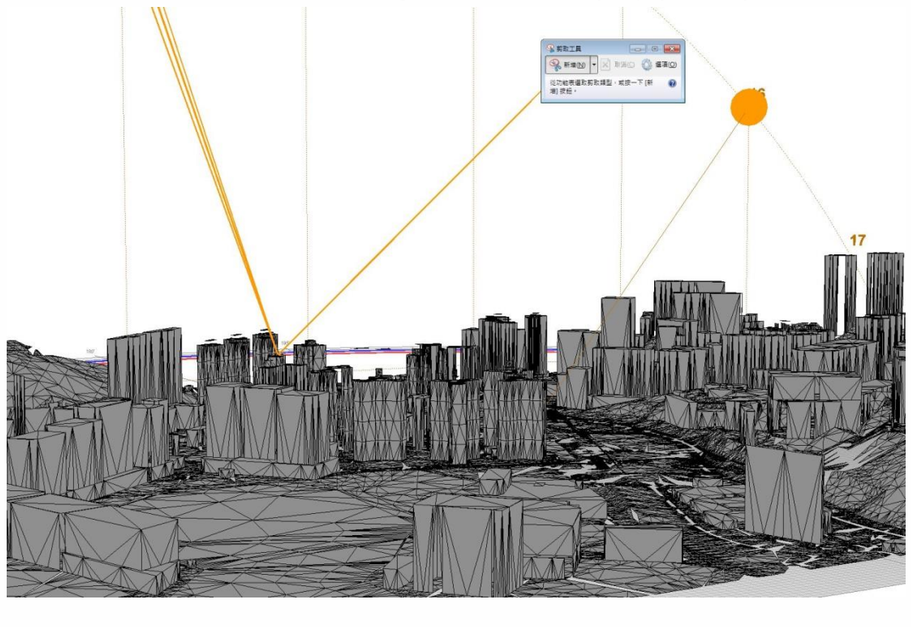


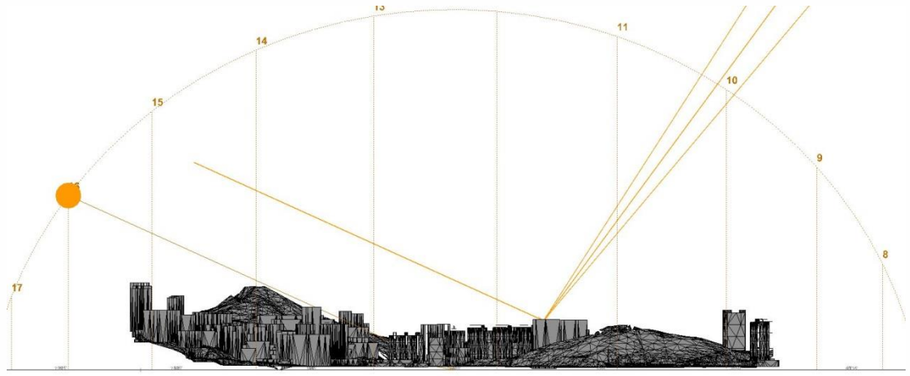
g. Set the Climate data to Hong Kong,

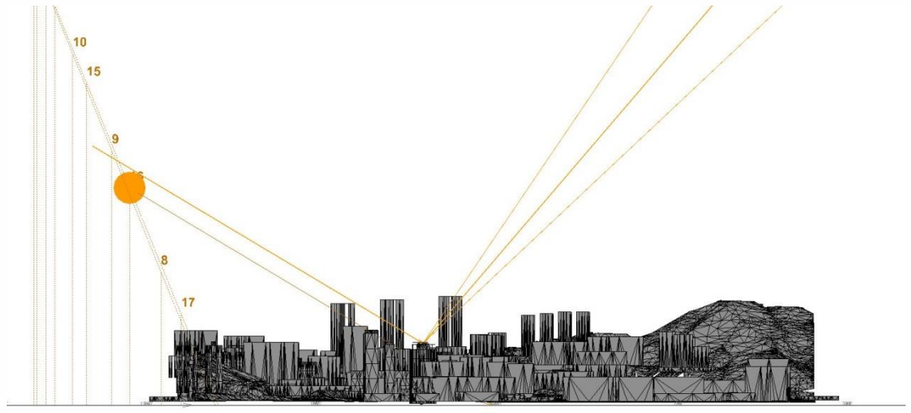
h. Set the Plan view(F5), Select all face of the PV panels



i. The software was calculated the Shading and Shadows and finally Display Solar Rays







6 BIM Study - Customization of Soft Landscape Library for BIM

Objectives

Landscape detailed designs generally involve planting various species, placing of planters, modifying local topography and other hard landscape features. In designing each specific landscape area with expecting greening effect, the application of huge numbers of species of plants is required.

In 2013, Landscape section started the study of customization of soft landscape library for BIM application in DCD. Although similar resources are available on the internet, general issues such as the following are encountered and considered inappropriate for government body:

(a) incomplete regional planting species database;
(b) no necessary information stored inside the components;
(c) no intellectual property rights; and
(d) subscription fee annually.

Status of the Study

Customization of soft landscape library 2013 has been completed. About 150 plant species in 3 catalogues (trees, shrubs and groundcovers) were developed.

Methodology

a) It involves three main steps namely, trimming tree photographs, generation of a RPC file and creation of a tree family file in Revit.
b) Trimming photos in Photoshop may take around 15 minutes per tree. It is pretty challenging to trim a natural tree edge for a sparse-leaved tree, e.g. the Willow.
c) Generating a RPC file using the RPC Creator is simple and fast. The RPC Creator 2013 was free software. There is a technical issue on repeated request for entering the authorization code.
d) Revit 2011 version does not update the RPC library automatically. This has to be done via administrator account. User might find it rather troublesome to import his/her own RPC file since Revit 2011 needs to restart the whole program to update the library.
e) The plant family file created contains different heights of the same type of plant. For shrubs, it is recommended to create a symbol representing more than one shrub, in order to reduce the time for placing the shrubs one by one.

Scope of Applications

1. Presentation showing initial planting concept and greening effect.
2. Variety of local species selection based on HD's Basic Plant List.
3. Availability of the most common plant species for handover and long term maintenance by EMD.
4. Incorporation of softwork elements into integrated BIM model.

Restrictions and Limitation

1. The colour of the photo is determined by the quality of rendering. The colour tends to fade out after rendering. The photo size for a high quality RPC can be up to 1MB or more. Angle change function cannot change the view of the plant species. The product might look artificial and not realistic enough. Top view will show the RPC as a linear element only.
2. Mixed planting area has to be done manually by placing the plants one by one.
3. Revit 2011 / 2013 version does not update the RPC library automatically.
4. RPC 2017 version requires annual subscription; license verification process with RPC server during rendering will be prohibited by HA security system.

Conslusion and Recommendation

Landscape design and greening effects as shown on certain projects presentation are impressive. However, the compatibility of software's different version can be reviewed by both the software developer and the users to enhance its applicability in different stage of landscape design.

Way Forward

More plant species are being under development to enrich the amount and varieties of species in soft landscape library.

7 Statutory Submission by using Revit for GBP and Foundation Plan Submission

BIMST conducted the trial statutory submissions of GBP and Foundation Plan using Revit. It is noted that the proposed presentation style of GBP and Foundation Plan by using Revit is only slightly different from those drawings prepared by CAD, but the content and result of these submissions is equivalent to the counterparts produced by CAD. It is to emphasize that, despite the slight difference in the presentation style noted while comparing with conventional CAD-produced drawings, the GBP and Foundation Plan produced by Revit can fulfill all the essential requirements stipulated in the Buildings Ordinace and its subsidiary regulations, relevant codes of practice and PNAPs. Some of these differences are highlighted below for Project Teams' reference during their preparation of statutory submissions using Revit:-

Description	Conventional Submission Format using CAD	Proposed BIM Submission Format using Revit
1 All the cells indicating the floor and the required min. dimentions of element of construction for different uses will be shown and those cells with same figure cannot be merged.	FIRE RESISTANCE REQUIREMENT (FRR) FOR ELEMENT OF CONSTRUCTION	FIRE RESISTANCE REQUIREMENT (FRR) FOR ELEMENT OF CONSTRUCTION

FIRE RESISTANCE REQUIREMENT FOR ELEMENT OF CONSTRUCTION

FLOOR	USE	CLASS	COMPARTMENT OF BUILDING FLOOR AREA (S.M.)	MIN. DIMENSIONS OF ELEMENT OF CONSTRUCTION BLOCKWORK THICKNESS	R.C.C. SLAB THICKNESS (THICK)	R.C.C. SLAB COVER TO STEEL	R.C.C. BEAM WIDTH (THICK)	R.C.C. BEAM COVER TO STEEL	R.C.C. COLUMN THICKNESS (THICK)	R.C.C. COLUMN COVER TO STEEL	R.C.C. WALL THICKNESS (THICK)#	R.C.C. WALL COVER TO STEEL	R.C.C. STAIR THICKNESS (THICK)	R.C.C. STAIR COVER TO STEEL
GRD.	LIFT LOBBY	1	120.404	100 [-/60/60]	100 [60/60/60]	20	100 [60/-/-]	30	200 [60/-/-]	25	75(120) [60/60/60] [-/60/60]#	15 (25)	95 [60/60/60]	20
	MAC ROOM	N/A	20.0											
	MAIN T.B.E. ROOM	N/A	45.829											
	FRESH AND FLUSH WATER PUMP ROOM	N/A	98.417											
	FS UPFEED WATER AND FS BOOSTER PUMP ROOM	N/A	55.044											
	JCP/MRP	SPECIAL HAZARD	23.7	225 [-/120/120]	225 [120/120/120]	35	200 [120/-/-]	50~	300 [120/-/-]	35	100(160) [120/120/120] [-/120/120]#	20 (25)	170 [240/240/240]	55
	RS&MRC	SPECIAL HAZARD	57.216											
	MAIN SWITCH ROOM	SPECIAL HAZARD	91.147											
	TRANSFORMER ROOM	SPECIAL HAZARD	150.617											
	EMER. 2 AT MEZZ LEVEL	SPECIAL HAZARD	12.849											
1/F~36/F	DOMESTIC	1	–	100 [-/60/60]	100 [60/60/60]	20	100 [60/-/-]	30	200 [60/-/-]	25	75(120) [60/60/60] [-/60/60]#	15 (25)	95 [60/60/60]	20
	ELECTRIC METER ROOM	N/A	–											
	TELECOM ROOM	N/A	–											
	REFUSE STORAGE & MATERIAL RECOVERY ROOM	SPECIAL HAZARD	8.457	225 [-/120/120]	225 [120/120/120]	35	200 [120/-/-]	50~	300 [120/-/-]	35	100(160) [120/120/120] [-/120/120]#	20 (25)	170 [240/240/240]	55
MAIN ROOF	REFUGE FLOOR	N/A	–	100 [-/60/60]	100 [60/60/60]	20	100 [60/-/-]	30	200 [60/-/-]	25	75(120) [60/60/60] [-/60/60]#	15 (25)	95 [60/60/60]	20
	CABLE ROOM	N/A	–											
	VENT DUCT ROOM	N/A	–											
	EMERGENCY GENERATOR ROOM	SPECIAL HAZARD	–	225 [-/120/120]	225 [120/120/120]	35	200 [120/-/-]	50~	300 [120/-/-]	35	100(160) [120/120/120] [-/120/120]#	20 (25)	170 [240/240/240]	55
LOWER ROOF	LIFT MACHINE ROOM	SPECIAL HAZARD	–											
	FRESH WATER BOOSTER PUMP ROOM	N/A	–	100 [-/60/60]	100 [60/60/60]	20	100 [60/-/-]	30	200 [60/-/-]	25	75(120) [60/60/60] [-/60/60]#	15 (25)	95 [60/60/60]	20
	PV METER ROOM	N/A	–											
G/F ~ ROOF	LIFT SHAFT	N/A	–	–	–	–	200 [120/-/-]	50~	300 [120/-/-]	35	100(160) [120/120/120] [-/120/120]#	20 (25)	–	–
	STAIRCASE	N/A	–	100 [-/60/60]	100 [60/60/60]	20	100 [60/-/-]	30	300 [60/-/-]	25	75(120) [60/60/60] [-/60/60]#	15 (25)	95 [60/60/60]	20

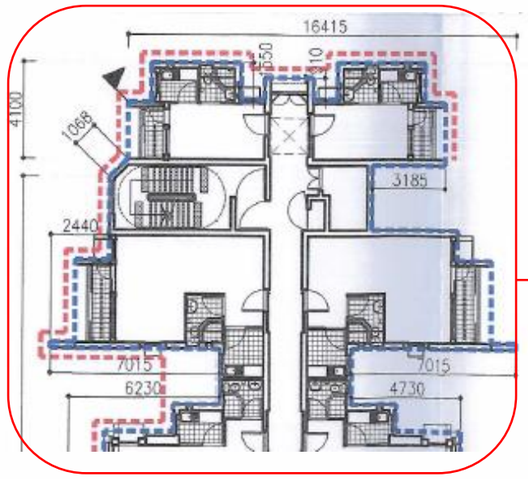
1

FIRE RESISTANCE REQUIREMENT FOR ELEMENTS OF CONSTRUCTION

LOCATION	USE	CLASS	COMPARTMENT OF BUILDING FLOOR AREA (m²)	MIN. DIMENSIONS OF ELEMENT OF CONSTRUCTION BLOCK THK.	R.C.C SLAB THK.	R.C.C SLAB COVER TO STEEL	R.C.C BEAM THK.	R.C.C BEAM COVER TO STEEL	R.C.C COLUMN THK.	R.C.C COLUMN COVER TO STEEL	R.C.C WALL => 1% V.R. THK.	R.C.C WALL => 1% V.R. COVER TO STEEL	R.C.C STAIR THK.	R.C.C STAIR COVER TO STEEL
G/F	LIFT LOBBY	1	153.403	100 [-/60/60]	100 [60/60/60]	20	100 [60/-/-]	30	200 [60/-/-]	25	75 (120) [60/60/60] [-/60/60]#	15 (25)	95 [60/60/60]	20
G/F	F.S UPFEED WATER AND F.S BOOSTER PUMP ROOM	N/A	66.247	100 [-/60/60]	100 [60/60/60]	20	100 [60/-/-]	30	200 [60/-/-]	25	75 (120) [60/60/60] [-/60/60]#	15 (25)	95 [60/60/60]	20
G/F	FRESH AND FLUSH WATER PUMP ROOM	N/A	93.029	100 [-/60/60]	100 [60/60/60]	20	100 [60/-/-]	30	200 [60/-/-]	25	75 (120) [60/60/60] [-/60/60]#	15 (25)	95 [60/60/60]	20
G/F	MAC ROOM	N/A	19.489	100 [-/60/60]	100 [60/60/60]	20	100 [60/-/-]	30	200 [60/-/-]	25	75 (120) [60/60/60] [-/60/60]#	15 (25)	95 [60/60/60]	20
G/F	MAIN T.B.E ROOM	N/A	45.588	100 [-/60/60]	100 [60/60/60]	20	100 [60/-/-]	30	200 [60/-/-]	25	75 (120) [60/60/60] [-/60/60]#	15 (25)	95 [60/60/60]	20
G/F	EMR 1	SPECIAL HAZARD	5.519	225 [-/120/120]	225 [120/120/120]	35	200 [120/-/-]	50~	300 [120/-/-]	35	100 (160) [120/120/120] [-/120/120]#	20 (25)	170 [240/240/240]	55
G/F	EMR 2 AT MEZZ LEVEL	SPECIAL HAZARD	12.739	225 [-/120/120]	225 [120/120/120]	35	200 [120/-/-]	50~	300 [120/-/-]	35	100 (160) [120/120/120] [-/120/120]#	20 (25)	170 [240/240/240]	55
G/F	J.C.P./M.R.P.	SPECIAL HAZARD	23.229	225 [-/120/120]	225 [120/120/120]	35	200 [120/-/-]	50~	300 [120/-/-]	35	100 (160) [120/120/120] [-/120/120]#	20 (25)	170 [240/240/240]	55
G/F	MAIN SWITCH ROOM	SPECIAL HAZARD	85.422	225 [-/120/120]	225 [120/120/120]	35	200 [120/-/-]	50~	300 [120/-/-]	35	100 (160) [120/120/120] [-/120/120]#	20 (25)	170 [240/240/240]	55
G/F	RS & MRC	SPECIAL HAZARD	54.059	225 [-/120/120]	225 [120/120/120]	35	200 [120/-/-]	50~	300 [120/-/-]	35	100 (160) [120/120/120] [-/120/120]#	20 (25)	170 [240/240/240]	55
G/F	TRANSFORMER ROOM (HV SWITCHGEAR COMPARTMENT)	SPECIAL HAZARD	68.413	225 [-/120/120]	225 [120/120/120]	35	200 [120/-/-]	50~	300 [120/-/-]	35	100 (160) [120/120/120] [-/120/120]#	20 (25)	170 [240/240/240]	55
G/F	TRANSFORMER ROOM (TRANSFORMER COMPARTMENT)	SPECIAL HAZARD	80.494	225 [-/120/120]	225 [120/120/120]	35	200 [120/-/-]	50~	300 [120/-/-]	35	100 (160) [120/120/120] [-/120/120]#	20 (25)	170 [240/240/240]	55
1/F-36/F	DOMESTIC	1	-	100 [-/60/60]	100 [60/60/60]	20	100 [60/-/-]	30	200 [60/-/-]	25	75 (120) [60/60/60] [-/60/60]#	15 (25)	95 [60/60/60]	20
1/F-36/F	ELECTRIC METER ROOM	N/A	-	100 [-/60/60]	100 [60/60/60]	20	100 [60/-/-]	30	200 [60/-/-]	25	75 (120) [60/60/60] [-/60/60]#	15 (25)	95 [60/60/60]	20
1/F-36/F	TELECOM ROOM	N/A	-	100 [-/60/60]	100 [60/60/60]	20	100 [60/-/-]	30	200 [60/-/-]	25	75 (120) [60/60/60] [-/60/60]#	15 (25)	95 [60/60/60]	20
1/F-36/F	REFUSE STORAGE & MATERIAL RECOVERY ROOM	SPECIAL HAZARD	9.462	225 [-/120/120]	225 [120/120/120]	35	200 [120/-/-]	50~	300 [120/-/-]	35	100 (160) [120/120/120] [-/120/120]#	20 (25)	170 [240/240/240]	55
MAIN ROOF	CABLE ROOM	N/A	-	100 [-/60/60]	100 [60/60/60]	20	100 [60/-/-]	30	200 [60/-/-]	25	75 (120) [60/60/60] [-/60/60]#	15 (25)	95 [60/60/60]	20
MAIN ROOF	REFUGE FLOOR	N/A	-	100 [-/60/60]	100 [60/60/60]	20	100 [60/-/-]	30	200 [60/-/-]	25	75 (120) [60/60/60] [-/60/60]#	15 (25)	95 [60/60/60]	20
MAIN ROOF	VENT DUCT ROOM	N/A	-	100 [-/60/60]	100 [60/60/60]	20	100 [60/-/-]	30	200 [60/-/-]	25	75 (120) [60/60/60] [-/60/60]#	15 (25)	95 [60/60/60]	20
MAIN ROOF	EMERGENCY GENERATOR ROOM	SPECIAL HAZARD	-	225 [-/120/120]	225 [120/120/120]	35	200 [120/-/-]	50	300 [120/-/-]	35	100 (160) [120/120/120] [-/120/120]#	20 (25)	170 [240/240/240]	55
LOWER ROOF	FRESH WATER BOOSTER PUMP ROOM	N/A	-	100 [-/60/60]	100 [60/60/60]	20	100 [60/-/-]	30	200 [60/-/-]	25	75 (120) [60/60/60] [-/60/60]#	15 (25)	95 [60/60/60]	20
LOWER ROOF	PV METER ROOM	N/A	-	100 [-/60/60]	100 [60/60/60]	20	100 [60/-/-]	30	200 [60/-/-]	25	75 (120) [60/60/60] [-/60/60]#	15 (25)	95 [60/60/60]	20
LOWER ROOF	LIFT MACHINE ROOM	SPECIAL HAZARD	-	225 [-/120/120]	225 [120/120/120]	35	200 [120/-/-]	50~	300 [120/-/-]	35	100 (160) [120/120/120] [-/120/120]#	20 (25)	170 [240/240/240]	55
G/F-ROOF	LIFT SHAFT	N/A	-	-	-	-	200 [120/-/-]	50~	300 [120/-/-]	35	100 (160) [120/120/120] [-/120/120]#	20 (25)	-	-
G/F-ROOF	STAIRCASE	N/A	-	100 [-/60/60]	100 [60/60/60]	20	100 [60/-/-]	30	200 [60/-/-]	25	75 (120) [60/60/60] [-/60/60]#	15 (25)	95 [60/60/60]	20

1

Description	Conventional Submission Format using CAD	Proposed BIM Submission Format using Revit
2.(a) Each line segment of the building facades served by the EVA is annotated with reference to the calculation table. 2.(b) The calculation for the total length of perimeter of building served by EVA (i.e. addition of all the line segments) will be presented in a vertical format.	LENGTH OF BUILDING FACADES ACCESSIBLE BY EVA	LENGTH OF BUILDING FACADES ACCESSIBLE BY EVA



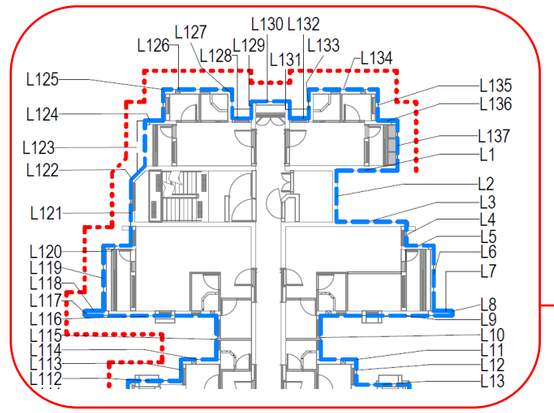
2(a)

TOTAL LENGTH OF PERIMETER OF BUILDING AT TYPICAL FLOOR :-

16415 + 1550 + 910 + 910 + 1550 + 36344 + 3185 + 3185 + 7015 + 4730 + 4730 + 4895 + 4335 + 1765 + 4385 + 1657 + 4405 + 13930 + 5985 + 1410 + 1410 + 16765 + 1630 + 1630 + 20890 + 4845 + 4845 + 6390 + 2762 + 6624 + 25450 + 4875 + 4710 + 4710 + 4875 + 16550 + 1440 + 1440 + 11475 + 5895 + 4730 + 990 + 1880 + 933 + 11880 + 4970 + 4852 + 4567 + 31785 + 3675 + 6530 + 6375 + 6230 + 6230 + 7015 + 2440 + 1068 + 4100 = 382752 mm

2(b)

TOTAL LENGTH OF PERIMETER OF BUILDING AT TYPICAL FLOOR WITHIN 10m OF E.V.A. :-



2(a)

TOTAL LENGTH OF PERIMETER OF BUILDING AT TYPICAL FLOOR:

MARK	DISTANCE (mm)	MARK	DISTANCE (mm)	MARK	DISTANCE (mm)
L1	3258	L47	4845	L93	1887
L2	2740	L48	5025	L94	4567
L3	3740	L49	3824	L95	4350
L4	1280	L50	2250	L96	3675
L5	1458	L51	2566	L97	2000
L6	3495	L52	2762	L98	5032
L7	981	L53	2610	L99	4775
L8	250	L54	2250	L100	1499
L9	7016	L55	4015	L101	250
L10	2350	L56	5025	L102	6374
L11	1902	L57	4925	L103	2350
L12	1350	L58	2350	L104	1898
L13	2830	L59	1950	L105	1350
L14	5750	L60	1350	L106	2807
L15	2830	L61	2810	L107	2750
L16	1350	L62	5750	L108	1524
L17	1902	L63	2810	L109	250
L18	2350	L64	1350	L110	1499
L19	4897	L65	1950	L111	2955
L20	5025	L66	2350	L112	2832
L21	4335	L67	4925	L113	1145
L22	4700	L68	5025	L114	1903
L23	1765	L69	6990	L115	2350
L24	1354	L70	990	L116	7019
L25	4385	L71	1550	L117	250
L26	1657	L72	990	L118	979
L27	4405	L73	7011	L119	3495
L28	2665	L74	5025	L120	1462
L29	5750	L75	4896	L121	3515
L30	3745	L76	2350	L122	460
L31	1175	L77	1900	L123	2855
L32	2309	L78	1350	L124	1400
L33	1175	L79	2830	L125	1675
L34	3746	L80	2750	L126	3700
L35	5750	L81	990	L127	1550
L36	1465	L82	1880	L128	1015
L37	2115	L83	1309	L129	910
L38	1630	L84	2485	L130	2050
L39	1550	L85	2805	L131	910
L40	1630	L86	1350	L132	1015
L41	2115	L87	1900	L133	1550
L42	1465	L88	1830	L134	3700
L43	4875	L89	1900	L135	1675
L44	9800	L90	3435	L136	1043
L45	4845	L91	1065	L137	2675
L46	2350	L92	2515	TOTAL=	379248

2(b)

Description	Conventional Submission Format using CAD	Proposed BIM Submission Format using Revit
3. The calculation for the travel distance from one point to another (i.e. addition of all the line segments indicated on the floor plan) will be presented in a vertical format.	TRAVEL DISTANCE TRAVEL DISTANCE FROM EXIT OF FLAT NO.13 TO THE NEAREST REQUIRED STAIRCASE TOTAL PROVIDED = u+v+w+x+y = 1.03+11.26+0.57+1.52+0.69 = 15.07 <24m(MAX ALLOWED) 3	TRAVEL DISTANCE TRAVEL DISTANCE FROM EXIT OF FLAT NO.13 TO THE NEAREST REQUIRED STAIRCASE MARK / DISTANCE PROVIDED (m) u 1.072 v 11.265 w 0.565 x 1.374 y 0.725 TOTAL= 15.001 < 24m (MAX ALLOWED) 3
4.(a) The calculation of the total of non-accountable GFA will be presented by a separate calculation table under ACS, Revit plug-in. 4.(b) The calculation of total domestic GFA will be presented in a text format.	GFA DOMESTIC GFA OF GROUND FLOOR PORTION / USAGE / AREA (m^2) 1 COVERED AREA 1,900.707 A PIPE DUCT (PD) -1.185 B PIPE DUCT (PD) -1.225 C PIPE DUCT (PD) -1.586 D PIPE DUCT (PD) -1.880 E PIPE DUCT (PD) -1.586 F PIPE DUCT (PD) -1.880 G PIPE DUCT (PD) -1.039 H PIPE DUCT (PD) -2.578 J PIPE DUCT (PD) -1.523 K PIPE DUCT (PD) -1.378 L PIPE DUCT (PD) -0.564 M PIPE DUCT (PD) -1.187 N PIPE DUCT (PD) -3.426 P PIPE DUCT (PD) -1.732 Q PIPE DUCT (PD) -1.045 R PIPE DUCT (PD) -0.564 S FS UPFEED WATER AND FS BOOSTER PUMP ROOM -55.044 T FRESH AND FLUSH WATER PUMP ROOM -98.417 TRANSFORMER ROOM U1 (HV SWITCHGEAR COMPARTMENT) -68.550 U2 (TRANSFORMET COMPARTMENT) -82.067 V MAIN SWITCH ROOM -91.147 W MAIN T.B.E. ROOM -45.829 X ELECTRICAL METER ROOM 1 (EMR 1) -5.475 Y ELECTRICAL METER ROOM 2 (EMR 2) AT HIGH LEVEL -13.421 Z TELECOM ROOM -16.884 AA REFUSE STORAGE & MATERIAL RECOVERY CHAMBER (RS&MRC) -57.216 AB MASTER WATER METER CHAMBER (MWMC) -2.821 AC DRAIN PIT -0.490 AD DRAIN PIT -0.670 AE HOSE REEL (HR) F.S. INLET (FSI) -0.736 AF HOSE REEL (HR) F.S. INLET (FSI) -0.823 AG HOSE REEL (HR) -0.855 AH HOSE REEL (HR) -0.874 AJ HOSE REEL (HR) -0.704 TOTAL = 1,334.306 .....D1 4(a)(b)	GFA DOMESTIC G.F.A. OF GROUND FLOOR (D1a) PORTION / USAGE / AREA (m^2) 3 COVERED AREA 1911.499 NON-ACOUNTABLE DOMESTIC G.F.A. OF GROUND FLOOR (D1b) A PIPE DUCT(PD) 1.100 AA REFUSE STORAGE & MATERIAL RECOVERY CHAMBER (RS & MRC) 54.059 AB MASTER WATER METER CHAMBER (MWMC) 3.067 AD DRAIN PIT 0.620 AE HOSE REEL (HR) F.S.INLET (FSI) 0.690 AF HOSE REEL (HR) F.S.INLET (FSI) 0.687 AG HOSE REEL (HR) 0.715 AH HOSE REEL (HR) 0.896 B PIPE DUCT(PD) 0.903 C PIPE DUCT(PD) 1.586 D PIPE DUCT(PD) 2.112 E PIPE DUCT(PD) 1.586 F PIPE DUCT(PD) 1.880 G PIPE DUCT(PD) 1.041 H PIPE DUCT(PD) 2.492 J PIPE DUCT(PD) 1.701 K PIPE DUCT(PD) 1.405 L PIPE DUCT(PD) 0.494 M PIPE DUCT(PD) 1.045 N PIPE DUCT(PD) 4.003 P PIPE DUCT(PD) 1.880 Q PIPE DUCT(PD) 1.274 R PIPE DUCT(PD) 0.495 S F.S. UPFEED WATER AND F.S. BOOSTER PUMP ROOM 66.247 T FRESH AND FLUSH WATER PUMP ROOM 93.029 U1 TRANSFORMER ROOM (HV SWITCHGEAR COMPARTMENT) 68.413 U2 TRANSFORMER ROOM (TRANSFORMER COMPARTMENT) 80.494 V MAIN SWITCH ROOM 85.422 W MAIN T.B.E ROOM 45.588 X ELECTRICAL METER ROOM 1 (EMR 1) 5.519 Y ELECTRICAL METER ROOM 1 (EMR 2) AT HIGH LEVEL 12.739 Z TELECOM ROOM 16.675 TOTAL= 559.857 4(a) TOTAL DOMESTIC G.F.A. OF GROUND FLOOR (D1) = D1a - D1b = 1911.499 - 559.857 = 1351.642 m^2 4(b)

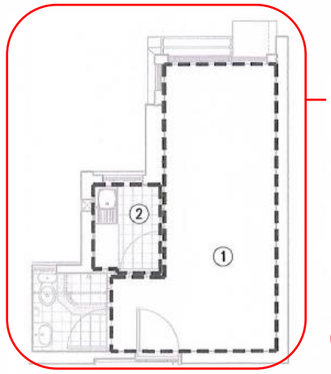
Description	Conventional Submission Format using CAD	Proposed BIM Submission Format using Revit
5.(a) All the cells indicating the location (i.e. floor) will be shown and those cells with same figure cannot be merged. 5.(b) The calculation of the total UFA will be shown in a vertical format, which is generated by Schedule under Revit.	UFA 5(a) 5(b)	UFA 5(a) 5(b)
6.(a) Hatching patterns are used to identify the different area for the calculation of UFA/UFS. 6.(b) The calculation of UFA and UFS will be presented in a text format.	UFS 6(a) 6(b)	UFS 6(a) 6(b)

TOTAL USABLE FLOOR AREA (UFA) PER FLOOR

FLOOR	FLAT NUMBER	AREA PER FLAT (m^2)	NOS. OF FLATS	AREA PER FLOOR (m^2)
F1 - F34	1	9.400	1	9.400
	6 & 7	11.240	2	22.480
	4, 9, 10, 22 & 23 3, 18 & 19	15.842	8	126.736
	2, 14 & 20	23.353	3	70.059
	5, 8, 12 & 13	26.010	4	104.040
	15 & 21	23.206	2	46.412
	11, 16 & 17	27.941	3	83.823
		TOTAL =	23	462.950
U.F.A. AT F1 TO F34 =				
462.950 x 34 STOREYS				15,740.300

TOTAL USABLE FLOOR AREA (U.F.A.) PER FLOOR

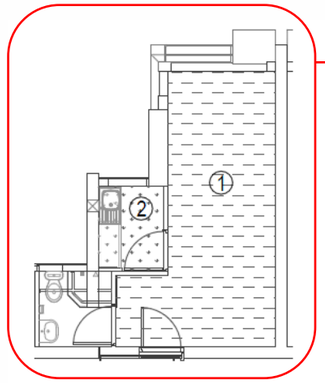
FLOOR	FLAT NOS.	AREA PER FLAT(m²)	NOS. OF FLATS	U.F.A. PER FLOOR (m²)	U.F.A. PER FLOOR (m²) x 34 STOREYS
F1-F34	1	9.371	1	9.371	318.614
F1-F34	2,14,15 & 20	23.339	4	93.356	3174.104
F1-F34	3, 18 & 19	15.834	3	47.502	1615.068
F1-F34	4, 9 ,10, 22 & 23	15.847	5	79.235	2693.990
F1-F34	5, 8 ,12 & 13	26.293	4	105.172	3575.848
F1-F34	6 & 7	11.394	2	22.788	774.792
F1-F34	11	27.795	1	27.795	945.030
F1-F34	16	27.803	1	27.803	945.302
F1-F34	17	27.952	1	27.952	950.368
F1-F34	21	23.036	1	23.036	783.224
TOTAL=		208.664	23	464.010	15776.340



FLAT NOS:	3, 18 & 19	
PORTION		AREA (m^2)
LIVING AREA	1	15.842
KITCHEN	2	2.574
USABLE FLOOR AREA (UFA) = PORTION 1		
	TOTAL	15.842
USABLE FLOOR SPACE (UFS) (INCLUDING KITCHEN) = PORTION 1 + 2		
	TOTAL	18.416

TYPE B–2 FLAT

(FLAT NO.: 3, 18 & 19 FROM F1 TO F36)



FLAT NOS.	PORTION		AREA (m²)
3, 18 & 19	LIVING AREA	1	15.834
3, 18 & 19	KITCHEN	2	2.576
		TOTAL=	18.410

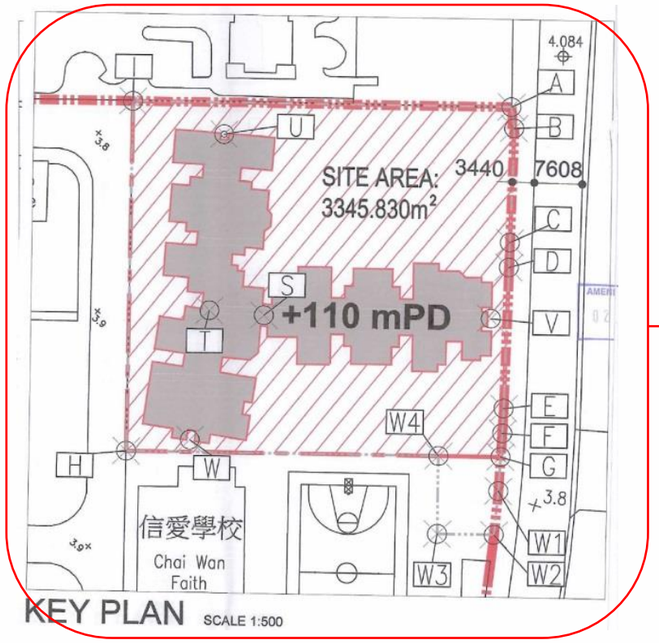
USABLE FLOOR AREA(U.F.A.)
= PORTION 1
= 15.834 m²

USABLE FLOOR SPACE(U.F.S.)(INCLUDING KITCHEN)
= PORTION 1+2
= 18.410 m²

TYPE B-2 FLAT

(FLAT NO:3,18 & 19 FROM F1 TO F36)

Description	Conventional Submission Format using CAD	Proposed BIM Submission Format using Revit
7.(a) The easting/northing co-ordinates of phase boundary will be shown on the Key Plan instead. 7.(b) The proposed table shows the distance between the consecutive phase boundary co-ordinate points.	SETTING OUT COORDINATES OF PHASE BOUNDARY	SETTING OUT COORDINATES OF PHASE BOUNDARY

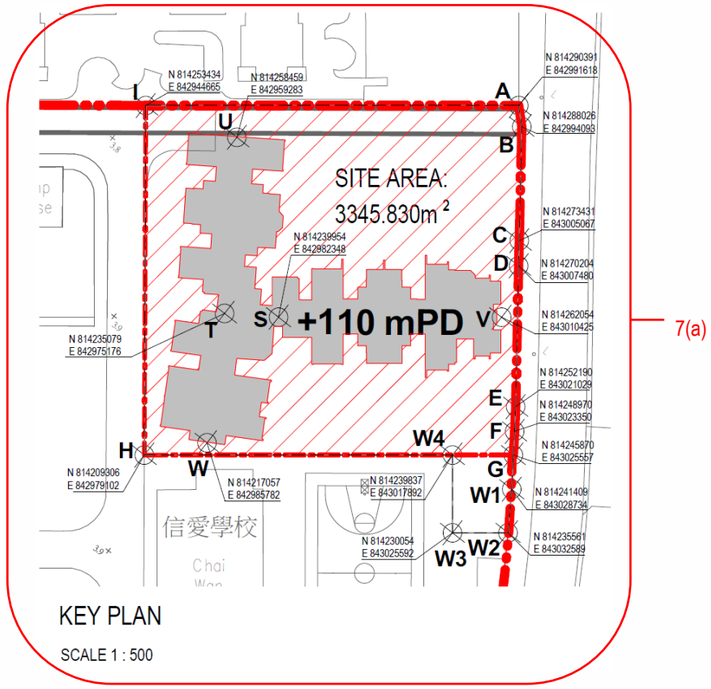


7(a)

SETTING OUT CO-ORDINATES OF PHASE BOUNDARY

POINT	EASTING	NORTHING	DISTANCE (m)
A	842 991.618	814 290.391	
B	842 994.093	814 288.026	LINEAR = 3423
C	843 005.066	814 273.431	LINEAR = 18260
D	843 007.480	814 270.204	LINEAR = 4029
E	843 021.029	814 252.189	LINEAR = 22542
F	843 023.349	814 248.970	LINEAR = 3969
G	843 025.557	814 245.870	LINEAR = 3805
H	842 979.102	814 209.306	LINEAR = 59118
I	842 944.665	814 253.434	LINEAR = 55975
A	842 991.618	814 290.391	LINEAR = 59753

7(b)

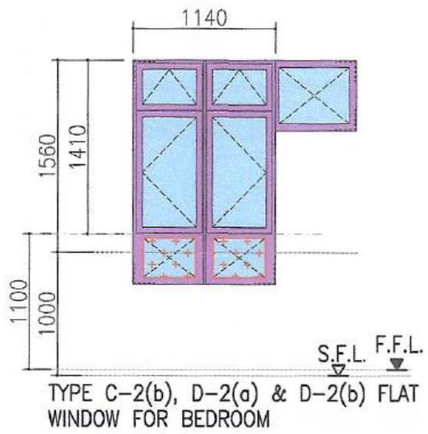
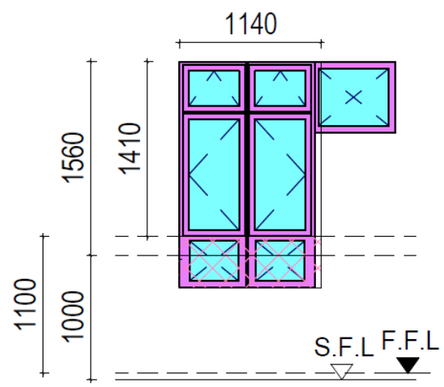


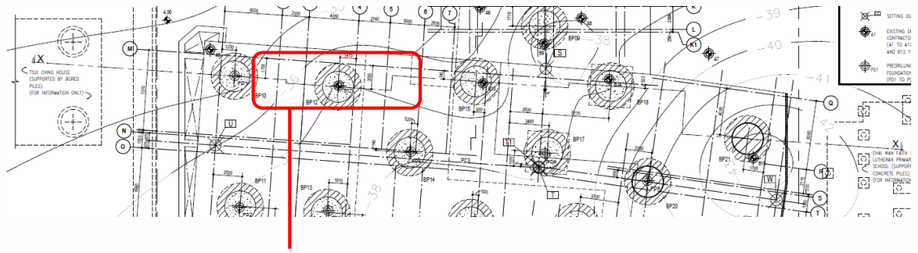
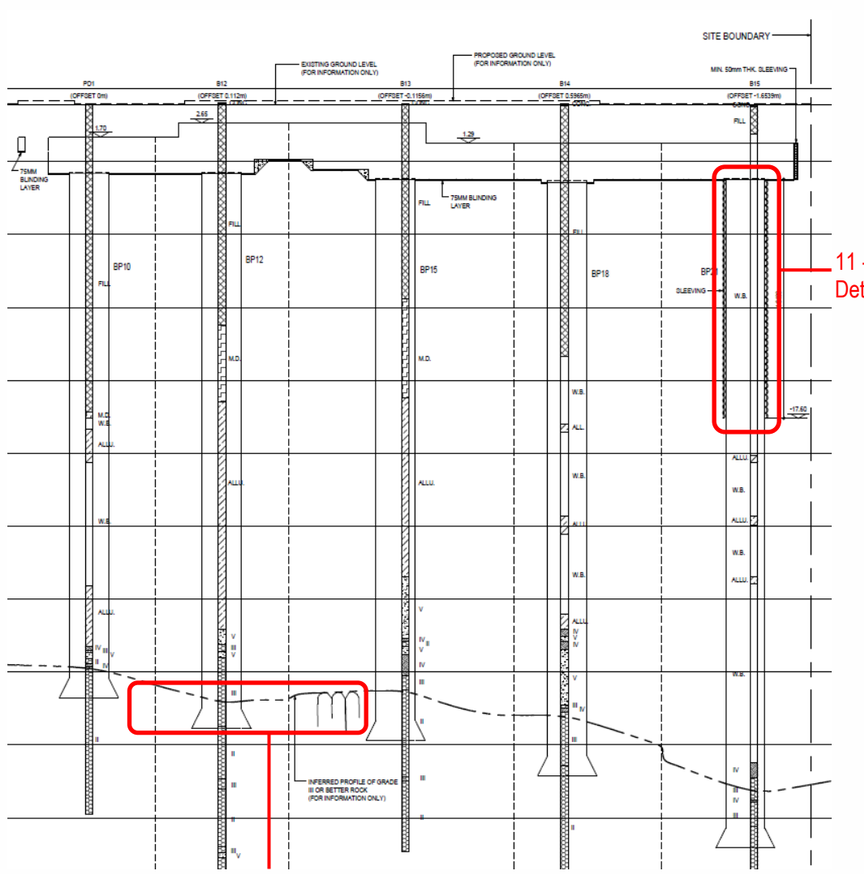
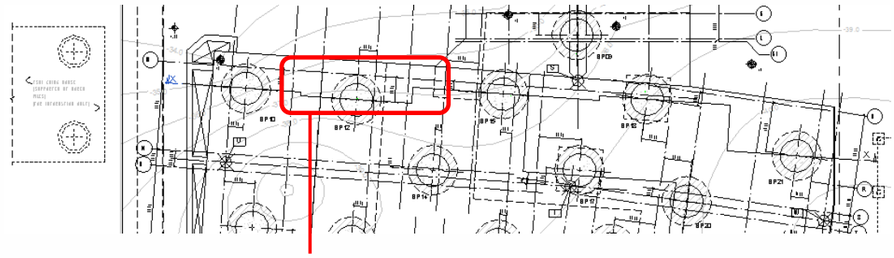
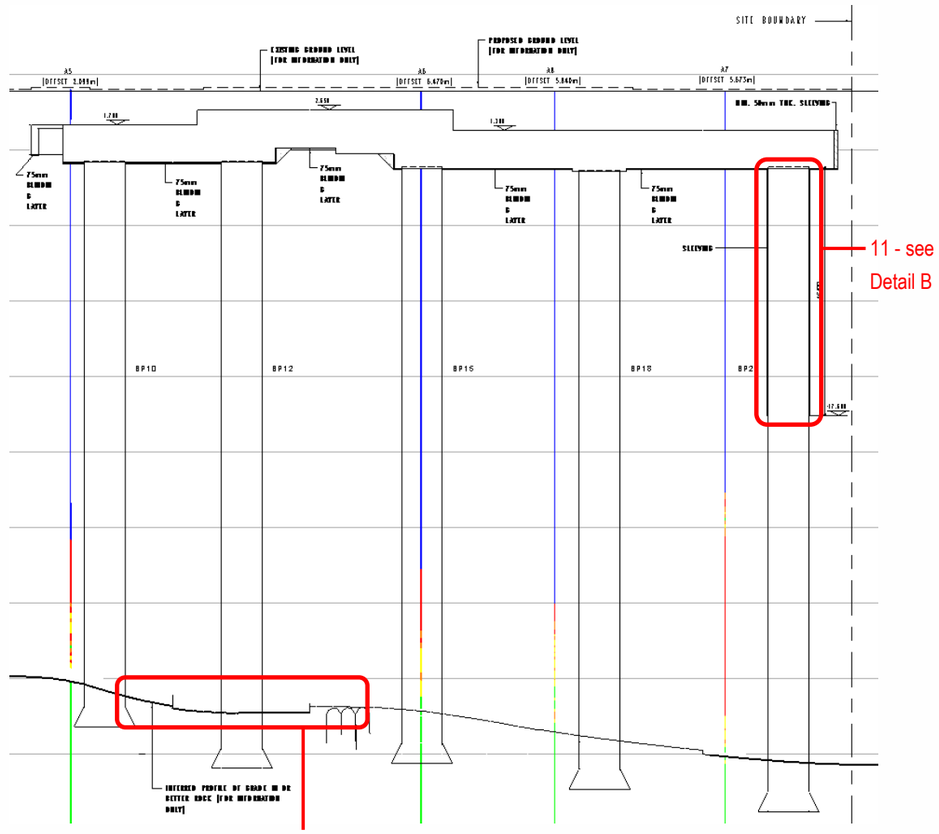
7(a)

SETTING OUT COORDINATES OF PHASE BOUNDARY

FROM	TO	DISTANCE (m)
A	B	3.423
B	C	18.260
C	D	4.029
D	E	22.542
E	F	3.969
F	G	3.805
G	H	59.118
H	I	55.975
I	A	59.753

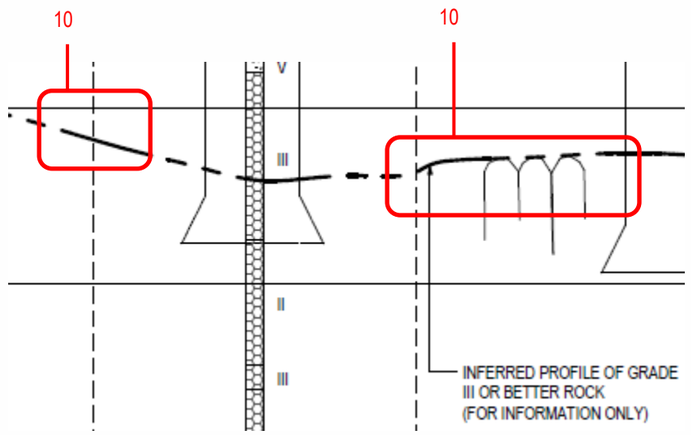
7(b)

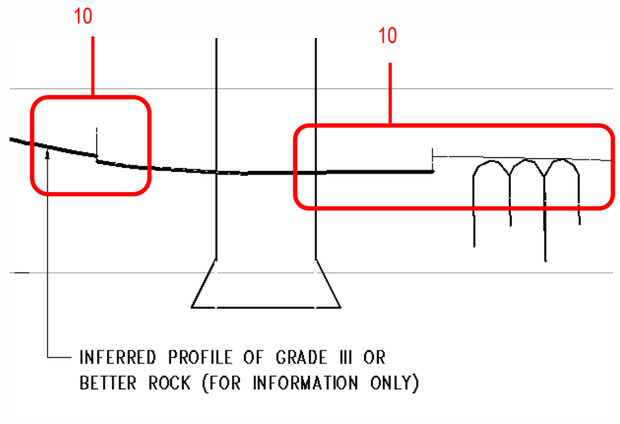
Description	Conventional Submission Format using CAD	Proposed BIM Submission Format using Revit
8. The calculation of the access to fireman's lift will be shown in a vertical format, which is generated by Schedule under Revit.	ACCESS TO FIREMAN'S LIFT ACCESS TO FIREMAN'S LIFT (LIFT NO.1 & 4) AT G/F TOTAL PROVIDED = a + b + c + d + e = 0.5 + 3.096 + 2.064 + 9.749 + 2.404 = 17.813 < 18m(MAX ALLOWED) DATE 8	ACCESS TO FIREMAN'S LIFT ACCESS TO FIREMAN'S LIFT (LIFT NO.1 & 4) AT G/F MARK / DISTANCE PROVIDED (m) a 2.300 b 9.813 c 2.623 d 2.690 e 0.515 TOTAL= 17.941 < 18m (MAX. ALLOWED) 8
9. The table for calculation of glazing area is generated by Schedule under Revit.	GLAZING AREA  TYPE C–2(b), D–2(a) & D–2(b) FLAT WINDOW FOR BEDROOM FLAT NO. 2, 11, 14, 15, 16, 17, 20 & 21 MARK MPW-X14 GLAZING AREA (1.140 x 1.560) x 0.68 = 1.209 m² OPENABLE AREA (1.140 x 1.410) x 0.68 = 1.093 m² 9	GLAZING AREA  TYPE C-2(a) , D-2(a) & D-2(b) FLAT WINDOW FOR BEDROOM AREA FLAT NO. / WINDOW MARK / PORTION TYPE / GLAZING LENGTH (m) / GLAZING WIDTH (m) / AREA PROVIDED(m²) (GLAZING LENGTH x GLAZING WIDTH) x 0.68 2, 14, 15, 16, 17 & 20 / MPW-X14 / GLAZING AREA / 1.140 / 1.560 / 1.209 2, 14, 15, 16, 17 & 20 / MPW-X14 / OPENABLE AREA / 1.140 / 1.410 / 1.093 9

Description	Conventional Submission Format using CAD	Proposed BIM Submission Format using Revit
10. Different contour line thicknesses are caused by zigzag movement of section and view depth of section defined in Revit. A contour break line is also caused by zigzag movement of section defined in Revit. 11. Only outline and extent of sleeving was displayed in sections of Revit drawings in lieu of conventional sleeving symbols.	<u>Foundation Layout Plan</u>  10 <u>Section X-X</u> 	 10 

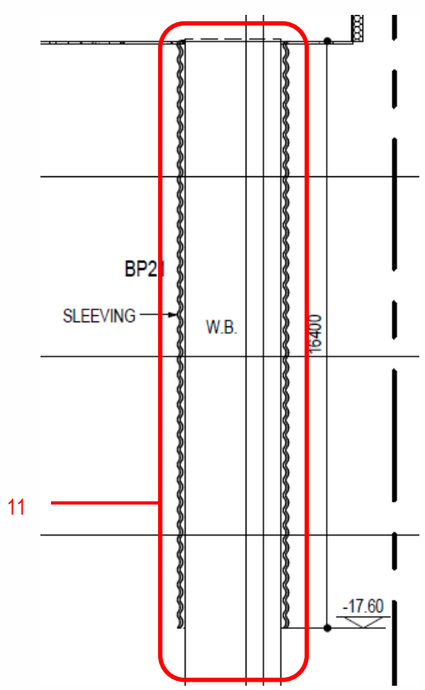
Description	Conventional Submission Format using CAD	Proposed BIM Submission Format using Revit

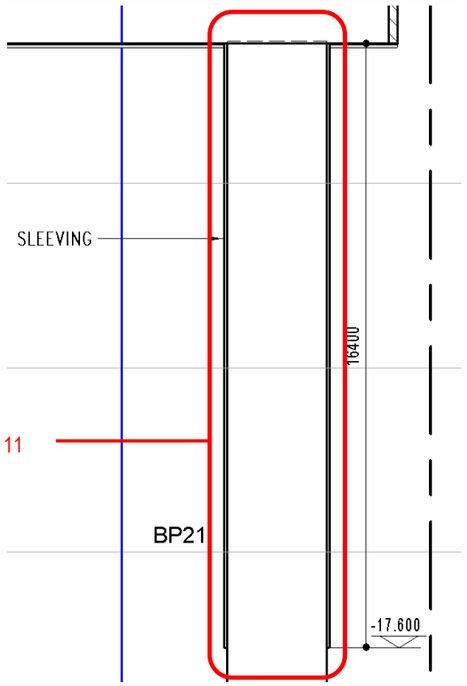
Detail A





Detail B





Note:

1. This is a trial GBP submission prepared by the BIMST solely for the agreement with ICU on the proposed BIM submission format. This submission is not meant to match the GBP submission made by the Project Team previously. Therefore, it is not necessary to have every figure to be equivalent to that in the BP submitted by the Project Team.
2. The proposed submission format made by Revit is only different in presentation style; its content and result are equivalent to the existing standards.
3. *The first approval GBP plan for the subject Wing Tai Road project was approved by ICU on 8 July 2016.

8 Resources

8.1 Hardware

Hardware shall refer to the latest HA hardware specifications and as per contract conditions.

Hardware requirements vary according to the number of participants, various building stages and complexity of projects. As a reference, for large multidisciplinary projects, the following hardware specifications are preferred for efficiency.

CPU type	Multi-core Intel® Xeon®, or i-Series processor or AMD® equivalent with SSE2 technology. Highest affordable CPU speed rating recommended. Revit productions will use multiple cores for many tasks, using up to 16 cores for near-photorealistic rendering operations. It should be noted, however, that up to Revit 2018 version, still only single core is being utilized for Revit operations.
Memory	Min 16GB RAM - As a general rule of thumb, RAM = 20 x Total File Size (Including Link Files) - This estimate is based on internal testing and customer reports. Individual models will vary in their use of computer resources and performance characteristics. - Models created in previous versions of Revit may require more available memory for the one-time upgrade process. - As projects progress, the amount of information and RAM used will increase through time. More RAM such as 32GB or 64GB may be needed to ensure the practicality of the models. Performance tests on RAM is being carried out at the time of this publication Nov 2017 and may be subject to review.
Video display	1920x1200 or higher with true colour, dual monitors
Video adapter	DirectX® 11 capable graphic card with Shader Model 3 as recommended by Autodesk at http://www.autodesk.com/revit-graphicshardware
Disk space	- 5GB free disk space - 10,000+ RPM (for Point cloud interactions) or Solid State Drive
Media	Download or installation from DVD9 or USB key
Ponting device	MS-Mouse or 3Dconnexion® compliant device
Browser	Microsoft® Internet Explorer® 11.0 (or later)
Connectivity	Internet connection for license registration and prerequisite component download

8.2 Operating System

Operating system	• Microsoft® Windows® 7 or later version, 64 bit for maximising memory utilization

8.3 Software

- It should be aware that BIM software is NOT backward compatible, i.e. cannot be saved as an earlier version. Once an older version file is read by later version software and saved, it will no longer be compatible with the older version software. The whole team has to upgrade to that later version software. Do discuss with whole project team before any software upgrade is launched.
- A strategy should be established among the project team on the software upgrades.
- For drawing production or analysis purposes, it is suggested that a consistent software platform should be adopted for the collaboration of BIM projects.
- If 3rd party applications are used, originators should ensure the all file versions are compatible.

• Major software and files types:

Software	Major function	File produce	File Type (could be adopt)
Revit	• Modelling • Drawing production • Simple walkthrough video • Rendering perspective • Quantity take off	• CAD formats • DWF • NWC (Navisworks) • ADSK • IFC • gbXML • TXT(schedule)	• Revit files • CAD files • Sketchup files • ACIS *.sat file • IFC • gbXML • FBX
Navisworks	• Quantity take off • Construction simulation • Animation	• Revit files • Most of 3D file formats	• Navisworks format
Design Review	• DWF drawing review • DWF drawing comparison and comment	• DWF	• DWF

8.4 Network

Giga bit Network is preferred, especially when the team is working in a worksharing mode as there are live monitoring of every user's activity by the central file.